



# Support study for the Impact Assessment for the Revision of EETS Legislation

(Directive 2004/52/EC & Decision 2009/750/EC)

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Final report for European Commission - DG MOVE  
MOVE/D3/2015-560 and MOVE/D3/2016-648



**Transport and  
Environmental  
Policy  
Research**



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## Executive summary

This is the final report for the study entitled 'Support study for the Impact Assessment accompanying the revision of the EETS Legislation (Directive 2004/52/EC AND Decision 2009/750/EC)', hereafter referred to as 'the study'. The report has been submitted by Ricardo, the consultants appointed to conduct this study.

The purpose of this report is to:

- Provide an overall summary of the methodology applied for the Impact Assessment
- Provide an overview of the problem definition and the policy options considered
- Summarise the outputs from the Impact Assessment of the policy options in Task 3
- Provide a comparison of the policy options based on the outputs from the Impact Assessment, with a recommendation for a preferred policy option to take forward.

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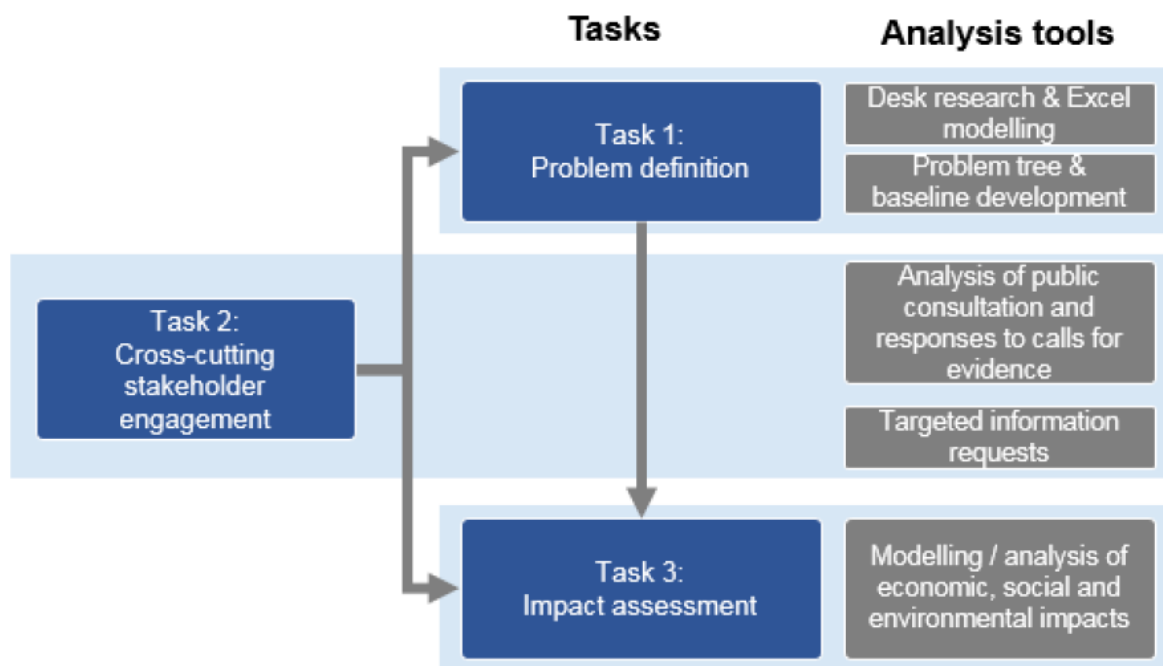
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# 1 Methodology – progress review

## 1.1 Overview of the methodology

An overview of the methodology is shown in Figure 1-1. This shows that the Tasks built upon on each other, but there was also an iterative element that entailed the refinement of earlier tasks based on new information uncovered in later tasks. This is particularly the case for Task 2 which fed heavily into both Tasks 1 and 3.

Figure 1-1: Overview of methodology



## 1.2 Task 1: Problem definition

Task 1 included eleven sub-tasks aimed at collecting the data and information necessary to develop a full understanding of the problems associated with the current implementation of EETS, the root causes of these problems and potential solutions that could be envisaged. The task also involved the production of an economic model of the costs to road users of the lack of interoperability of electronic tolling in the EU and development of a baseline defining the expected evolution of these issues over time in the absence of further EU-level action on EETS.

Task 1 has drawn heavily on the outputs of the consultation summaries and interviews carried out in Task 2, in order to fill any gaps in the data identified. The outputs of Task 1 were used to help refine the policy scenarios developed in Task 3, whilst the model developed in Task 1 was used as one of the main tools to carry out the Impact Assessment in Task 3.

### 1.2.1 Subtask 1.1: Review of problems and problem drivers

One of the key elements of the Impact Assessment was the refinement of the problem definition developed for the Ex-post Evaluation (European Commission, 2016), based on the various research activities in Task 1 and 2. The problem definition has been updated based on data collected from the literature review in Tasks 1.2 to 1.10 and the various stakeholder consultation and interview sub-tasks in Task 2.

These data have been used as a basis for further developing our understanding of the nature and scale of the problems, who is affected and the root causes of these problems. The revised problem definition has been described in detail in Section 2.1, including a revised problem tree diagram. Although we discussed the possibility of using an alternative approach to the presentation of the problem tree in the



inception report, we have opted for a simpler format, in line with that used in the Ex-post Evaluation, as shown in Figure 2-1.

The revised problem definition fed into a review of the policy options being considered by the Commission, in order to develop a series of modelling scenarios required to complete the Impact Assessment.

### 1.2.2 Subtask 1.2: Quantify in time and monetary terms the cost and hassle caused to road users by the lack of interoperability of electronic tolls in the EU and close neighbours (EEA, Switzerland, Western Balkans, Belarus, Russia, Turkey)

The main purpose of this subtask was to establish the costs to road users of the lack of interoperability of electronic tolling in the EU. Specifically, the Commission requested an Excel-based model to estimate, at an aggregate level and in monetary terms, the cost and time-losses for road users due to the lack of interoperability of electronic tolls in the EU, giving priority to heavy-duty vehicles (lorries and buses). 4iCom led the data collection for this subtask, with TRT producing the Excel model.

Modelling results have been provided for the baseline (developed in Task 1.11) in monetary terms, separately for EU hauliers and foreign hauliers (for the latter, less detailed assessment is provided), with disaggregation by a number of cost categories, including direct costs (rental / deposit costs, service fees, installation costs and driver training costs), indirect costs (administration costs, fines as a result of lack of interoperability) and time losses (during installation / removal and registration time / time spent at vending machines).

Inputs to the Excel-based model have been provided for each of the cost categories mentioned above and with respect to two types of technologies. The first type of technology considers the OBUs of EETS-provider (i.e., EETS OBU henceforth). The second type of technology considers the OBUs directly available from toll chargers (i.e., national OBU henceforth). The unit cost for each type of OBU has been estimated as a single average EU-wide figure using weighted averages based on the expected numbers of EETS OBUs, and national OBUs (see also the Task 1.11 on the definition of the baseline scenario).

#### 1.2.2.1 Data collection

Whilst some limited data was available from publicly available studies, the vast majority of usable data required was obtained from interviews with road users as part of the interview programme in Task 2.6. This was supplemented on a number of occasions by unsolicited submissions received by certain haulage companies, as well as by our analysis of responses to the questions related to costs in the Task 2.2 targeted questionnaire.

Based on the data provided to us by road users, we have been able to build a picture of the detailed business models as seen from the end users' perspective and have therefore used the Excel-based model to estimate the cost impact on road users from the lack of interoperability for a range of electronic tolling technologies.

#### 1.2.2.2 Modelling – assessment for HGVs

The Excel-based model developed to quantify the costs to road users caused by the lack of interoperability broadly reflects the methodology described in the inception report, except that the technology categories differ as set out in the description of cost categories provided above.

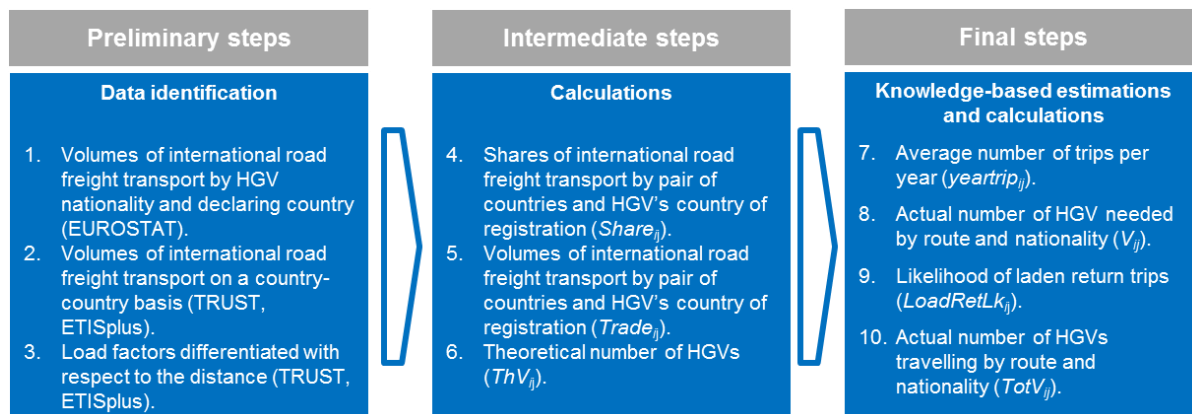
The volume of HGVs traffic between pairs of countries is based on the outputs from TRT's TRUST transport model, in combination with official figures derived from the Eurostat database. Data obtained were assembled in the form of a matrix covering the EU Member States and close neighbours (i.e., EEA, Switzerland, Western Balkans, Belarus, Russia and Turkey). The matrix represents the volumes of international road freight transport (i.e. tonnes) exchanged on a country-country basis<sup>1</sup>.

To recap, a ten step methodology has been developed (as presented in the inception report), as shown in Figure 1-2 and summarised through the main blocks of steps discussed below.

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<sup>1</sup> The matrix is a 40 by 40 table reflecting all possible Origin-Destination combinations amongst pairs of countries.

**Figure 1-2: Overall process for defining the number of HGVs traveling by route and nationality – and thereby the number of OBUs**



- Preliminary steps:** the volumes of international road freight transport have been identified on a country-country basis (i.e., *ij* pair)<sup>2</sup> (i.e., *Tons<sub>ij</sub>*). The volumes result from the data available from the EUROSTAT database.

In parallel, the volumes of international road freight transport have been extracted from the TRUST transport model (i.e. *Trade<sub>ij</sub>*). Similarly, the load factors for HGVs (i.e. *Load<sub>ij</sub>*) have been assumed according to input used in the TRUST transport model, which differentiates with respect to short, medium and long distances on international travel (i.e. 7, 10 and 14 tonnes per HGV, respectively).

- Intermediate steps:** according to data from the Eurostat database and outputs of the TRUST transport model, the outputs on the volumes of international road freight transport have been allocated in form of a matrix, on a country-country basis. The matrix has been populated directly using the *Tons<sub>ij</sub>* defined above. In the cases where data was not available, road freight transport volumes have been obtained by multiplying the data available from the TRUST transport model (i.e. *Trade<sub>ij</sub>*), by the shares of international road freight transport from the EUROSTAT database (i.e. *Share<sub>ij</sub>*).

The allocation of road freight transport obtained was then divided by the parameters *Load<sub>ij</sub>* (i.e., the load factors), resulting in an estimate of the theoretical number of HGVs (i.e. *ThV<sub>ij</sub>*), again in the form of a matrix on a country-country basis.

$$ThV_{ij} = Trade_{ij} / Load_{ij}$$

- Final steps:** the parameters *yeartrips<sub>ij</sub>* (i.e., the average annual number of trips per HGV between country pairs *i* and *j*) and *LoadRetLk<sub>ij</sub>* (i.e., the likelihood of laden return trips and for HGVs) were estimated in order to calculate the actual number of HGVs travelling amongst pairs of countries (i.e. *V<sub>ij</sub>*).

$$V_{ij} = ThV_{ij} / yeartrips_{ij}$$

The estimation of the yearly number of trips relied on the matrix of the average travel time on a country-country basis, as produced by the TRUST transport model. Specifically, two extreme

<sup>2</sup> Note that this preliminary step of the model has been modified with respect to the description in the inception report. The country *k* of registration of the vehicles has not been taken into account at this stage, but rather this has been used in Section 0 to estimate users' cost for EU and foreign hauliers. In terms of third countries declaring transport services between pairs of countries, the Eurostat database covers only the EU Member States, hence other sources of information have been investigated to provide separate results for EU and foreign hauliers. See national statistics of Norway (<http://www.ssb.no/en>), national statistics of Switzerland (<https://www.bfs.admin.ch>), Statistical Office of Republic of Serbia (2015) Total transport of passengers and goods and TRT, DIW ECON, ICF (2014), Study on the economic impact of an agreement between the EU and the Republic of Turkey.

situations have been assumed according to driving regulations<sup>3</sup>, typical logistics operators' practice and to reflect the fact that HGVs can operate both in international and domestic transport. On the one hand, if the average travel time is less than one day, the estimated yearly number of journeys is assumed equal to 140 considering the approximate number of operating working days; on the other hand, if the travel is longer than four days, the estimated yearly number of journeys is equal to 30 (considering the number of working weeks). Values in between have been assumed through interpolation.

The matrix developed based on this estimate was then adjusted to account for laden return trips. To this end, the calibration parameter  $LoadRetLk_{ij}$  on the likelihood of laden return trips was inferred based on the ratio of the theoretical number of HGVs travelling between each pair of countries, i.e. through calculating the ratio between the theoretical HGVs from  $i$  to  $j$  divided by the theoretical HGVs from  $j$  to  $i$ .

Again, two extreme situations were considered and interpolations used to estimate intermediate values, based on data available on laden return trips in some international cross-border road segments (e.g. the Mont Blanc road tunnel), as well as known logistics operator behaviour (Federal Office of Transport, 2015)(AECOM, 2014). If the flows were sufficiently balanced between the two directions, the probability of a laden return trip is low and the calibration parameter was assumed to be equal to 1.1; if the flows were strongly unbalanced (i.e., the ratio is lower than 0.5), the probability of a laden return trip becomes higher and the calibration parameter was assumed equal to 1.5.

Finally, the actual number of HGVs travelling between each pair of countries has been estimated based on the following equation.

$$TotV_{ij} = \left( MAX(V_{ij}; V_{ji}) + MIN(V_{ij}; V_{ji}) \right) \cdot LoadRetLk_{ij}$$

The equation above has been slightly adapted compared to that included in the inception report, to allow for easier manipulation of the data in the form of a matrix. However, the overall rationale remains unchanged.

In parallel to the estimation of the actual number of HGVs, the number of OBUs required for travelling between each pair of countries has been estimated and summarised in a second matrix again relying on the output of the TRUST transport model. These estimates take account of the fact that different paths may be possible when travelling between the same pair of countries. To reflect this, the estimated number of OBUs has been modified based on the allocation of volumes transported onto each possible path identified. In doing so, a unique average number of OBUs for both directions was obtained, and hence the matrix obtained is symmetric.

Finally, the quantification of the impact of the lack of interoperability of electronic tolls for road users is calculated by multiplying the estimated number of actual HGVs travelling between a pair of countries, by the number of OBUs needed on that path and by the average cost of the type of technology needed. This allows an estimation of the total cost borne in the scenario considered by summing outputs of this calculation for all the country pairs.

### 1.2.2.3 Modelling – assessment for buses

As in the case of the HGVs, the starting point for buses is the output of the TRUST transport model, which provides the volumes of international passengers on a country-country basis. It should be noted that the data available refers only to regular bus services<sup>4</sup> and that non-scheduled international services (e.g. tourist services) have not been included in this analysis. The number of buses providing non-scheduled services cannot be estimated with the available data, but is not expected to have a significant impact on the results of the analysis.

<sup>3</sup> See Regulation (EC) No 561/2006 on the harmonisation of certain social legislation relating to road transport, Directive 2002/15/EC on the organisation of the working time of persons performing mobile road transport activities and Directive 2006/22/EC on minimum conditions for the implementation of social legislation relating to road transport activities.

<sup>4</sup> The output of the TRUST transport model relies on the extrapolation of the ETISplus project (see ETISplus D6 Database Manual, Passenger database construction, Annex Report D6). The ETISplus project produced a European matrix of national and international buses transport activity. Limitations were highlighted regarding data collection as there is no obligation for provision of official statistics and there is no common definition of long distance services between countries. The matrix built covers regular bus services only. Other dedicated services (e.g., event-related and limited seasonal services) are excluded from data collection. The geographical coverage of the matrix obtained coincides with that used for HGVs.

To obtain the theoretical number of buses (i.e.  $ThV_{ij}$ ), the number of passengers was divided by an average load factor assumed equal to 25 *pax/vehicle*. Furthermore, the parameters  $yeartrips_{ij}$  were estimated in order to calculate the actual number of buses travelling between pairs of countries (i.e.  $V_{ij}$ ).

$$V_{ij} = ThV_{ij} / yeartrips_{ij}$$

The estimation of the yearly number of trips relied on the matrix of the average travel time on a country-country basis, as produced by the TRUST transport model. Specifically, two extreme situations have been assumed. On the one hand, if the average travel time is less than one day, the estimated yearly number of journeys is assumed equal to 140 considering the approximate number of operating working days; on the other hand, if the travel is longer than three days, the estimated yearly number of journeys is equal to 60. Values in between have been assumed through interpolation.

Unlike for HGVs, there is no need to adjust with respect to the parameter  $LoadRetLk_{ij}$  due to the symmetric nature of the matrix of the volume of international passengers, i.e. the fact that outbound and return trips have similar load factors.

The number of OBUs required for travelling between each pair of countries has been estimated following the same method carried out for HGVs.

Finally, as in the case of the HGVs, the quantification of the impact of the lack of interoperability of electronic tolls for road users is calculated by multiplying the estimated number of actual buses travelling between a pair of countries, by the number of OBUs needed on that path and by the average cost of the type of technology needed.

#### 1.2.2.4 Modelling – assessment for cars

As in the case of the HDVs, the starting point for cars is the output of the TRUST transport model, which provides the number of trips per day on a country-country basis. The data available is split between two categories of users, namely commuters and non-commuters.

To obtain the number of vehicles, the number of users was divided by the corresponding load factors. To this end, the average load factor for commuters was assumed (based on assumptions used in the TRUST model) to be equal to 1.5 passengers per vehicle and the average load factor for non-commuters was assumed to be equal to 1.9 passengers per vehicle. Based on this, a matrix of theoretical vehicle numbers between country pairs was obtained on a country-country basis.

The two categories of users assumed reflect two possible situations worth considering for the impact assessment. On the one hand, the commuter category represents users travelling more frequently over a short distance, e.g. for business or work purposes and between two places close to a border; on the other hand, non-commuters may represent the occasional users travelling for leisure or tourism and over a long distance. Based on the above, the number of theoretical vehicles was re-estimated to reflect the real need to equip a car with an interoperable OBU.

In the case of commuters, it is more likely that the users will travel on a frequent or daily basis and as such they are assumed to travel at approximately this frequency, i.e. 350 times per year. For non-commuters, three assumptions were made to refine the frequency of journeys. Namely, non-commuters have been categorised as being either: (i) non-commuters travelling between bordering countries once a week, due to the short distance amongst the countries; (ii) non-commuters travelling between non-bordering countries within a distance of less than 1,500 km and assumed to be travelling once per month; and (iii) non-commuters travelling between other countries and assumed to travel once per year.

As a result, the actual number of cars was calculated by dividing the theoretical number of cars per origin-destination pair, by the parameter  $yeartrips_{ij}$ ; according to the assumptions described above, the annual numbers of trips for each of the respective categories described above are 350 for commuters and i) 52; ii) 12; and iii) 1 for non-commuters, respectively.

The number of cars obtained above is the potential of actual vehicles travelling cross-border for both commuters and non-commuters. The number of vehicles that need to be equipped with an OBU has been obtained by estimating the incidence of vehicles that would adopt an OBU compatible with an interoperable electronic toll collection systems, for both the commuter and non-commuter categories. Specifically, a penetration rate of OBUs amongst international travellers lower than 100% (i.e., the best

case scenario) was assumed: a rate of 80% of penetration of OBUs for commuters and 44%<sup>5</sup> for non-commuters was assumed, as a smaller fraction of them are likely to use an interoperable OBUs for their infrequent journeys (Telepass, 2016), (Autostrada del Brennero, 2012). The penetration rates assumed refer only to cars travelling on international journeys.

Finally, the analysis of passenger car road users has been extended in two ways: firstly to estimate the cost of lack of integration of EETS systems with urban congestion charging systems, which are not open to EETS providers; secondly, to assess the lack of integration of EETS systems with toll domains where vignette charging systems are in place. In both cases, car road users have to independently manage both the registration procedures and the payment procedures. Time losses have been estimated to assess the lack of interoperability amongst the systems for international car journeys through domains where congestion charging or vignette charging are in place in 2016. Note that this analysis is not designed to be extended to future years in the baseline and purely provides a reference figure for the cost of lack of interoperability today.

### 1.2.3 Subtask 1.3: Quantify in monetary terms the costs of lack of interoperability of electronic tolls for toll chargers

This part of the study aimed at estimating the impact that the lack of interoperability has on toll chargers, in particular by estimating how the development, set-up and operational costs of a tolling system may be reduced if:

- the systems were designed to run successfully with OBUs already present on the market;
- investment and system management were shared with other states/toll chargers.

4iCom led this subtask and developed different case studies to demonstrate how implementation and operational costs are influenced by the lack of interoperability. As development, set-up and operational costs are often regarded as commercially sensitive for both toll chargers and suppliers (equipment manufacturers and system integrators and operators), the aim was to develop estimates of the various cost items based on a number of specific case studies for which we can obtain cost data.

This method was deemed appropriate given that the main cost elements contributing to the development, set-up and operating costs of an electronic tolling system based on a particular technology type were expected to be very similar across different markets (even if some may change depending on the labour costs in a specific country). However the potential savings that a toll charger can access are strongly affected by the overall context in which the electronic tolling system is implemented and operated, for example as a function of the adopted technology, the size of the system (network and road users), the type of road users and the characteristics of the traffic (e.g. mostly intra-national or with a significant international share).

We have therefore developed reference cost models for toll domains based on the technology types relevant to the study:

- A nationwide DSRC<sup>6</sup>-based free-flow electronic tolling system for heavy good vehicles;
- A nationwide GNSS/GPRS-based free-flow electronic tolling system for heavy goods vehicles;
- A local DSRC-based (together with other more traditional payment means) free-flow electronic tolling system for all vehicles;
- A local DSRC- and ANPR-based free-flow electronic tolling system for all vehicles that includes all the different types of schemes currently deployed in Europe.

The input data for the various cost models has been obtained from information already available to us, supplemented by data from available literature (reports including for example from the REETS project (REETS, 2014), presentations, etc.) and data collected directly from interviews with stakeholders (for example DARS for Slovenia, Viapass and Satellic for Belgium, the concessionaire NV Liefkenstoek Tunnel and for the Dartford Crossing). The full list of cost data points collected were described in detail in the study inception report.

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<sup>5</sup> This penetration rate for the non-commuters is a weighted average based on the frequency of international travel for the different non-commuter types established above and assuming: (i) 80% penetration of OBUs for non-commuters travelling on a weekly basis, (ii) 60% for non-commuters travelling monthly and (iii) 10% for non-commuters travelling yearly.

<sup>6</sup> Dedicated Short Range Communication

The data collected has been anonymised and aggregated to ensure confidentiality, whilst for certain data points not available from the interviews, we have extrapolated using existing data and verified these estimates with the interviewees as part of the Task 2.6 interviews. We have also supplemented the data collection for Task 1.3 from our analysis of responses to the questionnaire sent to stakeholders as part of the targeted consultation in Task 2.2, where a number of questions cover aspects relevant to Task 1.3.

By developing cost models for a range of different system types, we have assigned a cost model to each market relevant to the study, thereby allowing us to estimate at a high-level the EU-level costs of lack of interoperability for toll chargers in the scenarios as part of the next phase of the Impact Assessment.

#### 1.2.4 Subtask 1.4: Quantify in monetary terms the costs of toll evasion for toll chargers due to the lack of co-operation between Member States on cross-border enforcement

One of the key problems that the ex-post evaluation has outlined regards the lack of cooperation between Member States on cross-border enforcement for tolling purposes. The so called Cross-border Enforcement Directive (EU 2015/413) in fact does not force Member States to share information about foreign road users for toll enforcement purposes and hence the information available between Member States is patchy.

In order to assess the extent of the problem, within this task the Commission has asked us to:

- assess the scale of toll evasion by foreign vehicle operators (light and heavy goods vehicles) for different type of tolling schemes (free-flow vs tolls with barriers) and compare it with the level of evasion by local users;
- identify the local initiatives that proved to be efficient to reduce toll evasion
- provide a list of existing bilateral and/or multilateral agreements (including the main provisions thereof) between Member States on the exchange of vehicle registration data with the purpose of recovering unpaid tolls;
- describe the use by toll chargers of private companies to recover unpaid tolls from vehicles registered abroad, listing the main players on the market, describing their operating models and the average costs of recovery and estimating how many toll chargers are making use of them, in order to understand their effectiveness;
- use the above information to evaluate in monetary terms the cost of unpaid tolls for toll chargers (separately for national and foreign vehicles),

4iCom led these activities and developed an analysis of the market in terms of the different approaches to toll evasion management, through consulting with toll chargers and toll recovery agencies. We were successful in interviewing several toll chargers (see Task 2.6 summary for a full list of those interviewed, Section 1.3.6) who provided some very useful insights as to the scale of the toll evasion problem for different toll recovery methods. Unfortunately however, we were not successful in engaging with any of the toll recovery agencies, despite repeated attempts to contact EPC, Atradius and NIVI-Credit. As such, our analysis is more heavily focused on approaches taken by toll chargers directly, rather than on approaches involving third party debt collection agencies.

Data collected from the toll charger interviews was also supplemented by both unsolicited responses received by toll chargers and our analysis of responses to the questionnaire sent to stakeholders as part of the targeted consultation in Task 2.2, where a number of questions covered aspects relevant to Task 1.4.

ASECAP is currently conducting a study amongst their members to collect information about enforcement issues, to be released in 2017. The main focus of this study is on the following aspects:

- The different procedures in place in the different toll domains for fine and toll recovery, both for domestic and foreign drivers;
- The applicable legislation for toll evasion (i.e. tax evasion or traffic regulation offence);
- The share of lost toll revenue due to toll evasion;
- An evaluation of related costs.

### 1.2.5 Subtask 1.5: Analyse main legal and contractual obstacles to the access of EETS providers/independent toll service providers to the toll collection market

Companies wishing to become EETS providers in the EU market have been and are indicating that legal and contractual obstacles still exist in many countries that prevent them from fully exploiting the market. As part of this task the Commission required an overview of the obstacles that have been identified in various countries where electronic toll collection systems are in place. Such obstacles may include:

- legal barriers (such as lack of legislation or legislation limiting the access to the market);
- contractual barriers (presence of clauses that protect existing players and/or that discriminate the access to the market of other companies);
- technical barriers (such as technical specifications that prevent other players from entering the market);
- obstacles resulting from existing concession contracts;
- other forms of discrimination.

In order to carry out such analysis, there was a need to understand the nature of any such legal and contractual barriers and obstacles in a cross-section of countries, in particular if and how national legislation or regulation intended to implement the EETS legal framework has impeded EETS providers from entering the market, and then to analyse the conditions (technical, contractual and procedural) that have been laid out for the accreditation/registration of EETS providers. In doing so it was additionally necessary to examine any problems encountered during the tendering process, in order to throw light on whether, for example, the non-discrimination provisions of Article 5.3 of Decision 2009/750/EC are being observed.

CSES led this subtask, supported by 4iCom in setting up interviews in particular. Whilst some of the information necessary to carry out Task 1.5 was obtained from the literature (for example the outputs of the REETS project (REETS, 2014) and other publications from the likes of AETIS (AETIS, 2016)), many of the more detailed inputs were provided from interviews with stakeholders in Task 2.6 (see Section 1.3.6 for a summary of all the interviews carried out as part of Task 2.6).

In addition to the interviews, CSES has drawn valuable inputs from the various responses to the questionnaire sent to stakeholders as part of the targeted consultation in Task 2.2, where a number of questions covered aspects relevant to Task 1.5. Finally, we have also drawn from responses to the public consultation position papers submitted under Task 2.4.

### 1.2.6 Subtask 1.6: Assess the technological and procedural differences between existing (and/or upcoming) electronic tolling systems and their impact on the achievement of interoperability and the provision of a European Electronic Toll Service

The EU market for electronic tolling systems is characterised by systems that differ in terms of technical solutions and operational procedures, making it potentially very complicated and expensive to establish truly interoperable services.

The situation has improved somewhat since the introduction of the EETS Directive and Decision. Although most electronic toll collection systems that are currently in operation conform to the EETS legal framework (in particular those implemented after the Directive and Decision came into place), many have adopted different architectures and solutions, within the boundaries allowed by the legal and standardisation framework.

In some case, differences depend on different applicable functional and technical requirements; in other cases they depend on different solutions that have been defined by suppliers and/or system integrators. The purpose of this subtask, led by 4iCom, was to report on the key differences (in relation to the different requirements where applicable) that constitute obstacles to technical and procedural interoperability across the EU.

To this end, our team has drawn heavily on in-house knowledge of the characteristics of the key electronic toll systems developed through existing work carried out by 4iCom (4iCom, 2015a) (4iCom, 2015b). We have supplemented this knowledge with outputs from the literature (for example from the REETS project (REETS, 2014), from our summary of the outputs from the questions covering technical

matters in the targeted consultation questionnaire for Task 2.2, as well as from information collected directly from equipment manufacturers and toll operators through the interviews carried out as part of Task 2.6 (see Section 1.3.6 for a summary of all the interviews carried out as part of Task 2.6).

4iCom has used this knowledge to develop an overview of all existing systems and to outline existing differences that prevent or make interoperability complicated, with particular attention given to interfaces and to interoperability constituents.

The analysis covered all countries where tolls are collected from HDVs, in particular Portugal, Spain, France, Ireland, Belgium, Germany, Italy, Croatia, Austria, Greece, Hungary, Slovak Republic, Slovenia, Czech Republic and Poland. The outcome of the analysis is a list of the main problematic requirements and other key differences preventing interoperability. Outputs from the research associated with Task 1.6 also fed into the cost data collection required for Tasks 1.2 and 1.3.

### 1.2.7 Subtask 1.7: Assess remaining gaps in the standardisation framework

One of the problems that was outlined by the Ex-post Evaluation of the EETS legal framework is the lack of full harmonisation of the technical characteristics of the different systems, in particular caused by the gaps that still exist in the technical standards that have been developed and approved.

The consequence of this lack of harmonisation of standards is the implementation of electronic toll systems that are not fully compatible, although they are all compliant with the requirements specified by the EETS legal framework.

4iCom led this sub-task to develop a critical review of the standardisation framework (for all types of technical solutions, in particular DSRC and GNSS) outlining the existing gaps to be filled in by the standardisation process in the EU.

In particular they have identified:

- which existing standards are not sufficiently precise (leaving room for interpretation) or prescriptive (integrating options/profiles that do not ensure full interoperability);
- which standards need to be newly developed in order to support the definition of interoperable electronic tolling equipment, interfaces and processes.

The information required for this task has been obtained from 4iCom's existing expertise, interviews with standardisation experts as part of Task 2.6 (see Section 1.3.6 for a summary of all the interviews carried out as part of Task 2.6), unsolicited responses received as part of Task 2.4 and responses to the questionnaire sent to stakeholders as part of the targeted consultation in Task 2.2.

### 1.2.8 Subtask 1.8: Provide a comparison of the practices of accreditation of EETS providers, and identify best practices

Since the EETS Directive and Decision were introduced, most countries and toll domains have transposed the Directive into national laws, developed and published toll domain statements and established a procedure to register and certify EETS providers. The Commission requires an overview of the models of accreditation that have been adopted by Member States and/or toll chargers.

For each relevant toll domain and/or EU Member State, 4iCom first collected the toll domain statements which are usually published on the internet. The available toll domain statements provided a certain level of understanding of the accreditation procedure applied to the toll service providers.

Our team then identified a sub-set of countries for which to develop a more detailed analysis, giving priority to those countries (including for example France, Italy and Belgium) where accreditation procedures have been already started and/or completed. Here we have supplement the freely-available information with evidence collected from both the summary of responses to the questionnaire sent to stakeholders as part of the targeted consultation in Task 2.2, and interviews with Member States, toll chargers and EETS providers as part of Task 2.6 (see Section 1.3.6 for a summary of all the interviews carried out as part of Task 2.6).

### 1.2.9 Subtask 1.9: Assess how the legal classification of tolls affects the business case and administrative hurdles for EETS/independent toll service providers

The Commission requires an overview of the legal classification of tolls (as taxes, charges or other classification) applying in all the EU Member States, and an understanding of how such classifications



impact on the choice of the business relationship between the toll chargers and the service provider (“reseller” vs “agent” model). This business relationship can have a significant impact on the form which an EETS provider can take and therefore its revenue generating capabilities.

4iCom worked closely with CSES to investigate this impact as part of Task 1.9. The two partners worked closely together to share knowledge on the EETS legal framework and of the specific applications in different countries. Information related to Task 1.9 was collected as part of the interviews covering other key tasks in the interview programme as part of Task 2.6 (see Section 1.3.6 for a summary of all the interviews carried out as part of Task 2.6).

### 1.2.10 Subtask 1.10: Assess links to personal data protection

The Ex-post Evaluation highlighted a number of issues encountered during the implementation and operation of electronic toll collection systems in Europe as a result of data protection legislation, which have resulted in system integrators and operators modifying their system architecture in order to comply with the relevant data protection legislation (either at EU level or in different countries).

Such requirements may have a significant impact on the system characteristics and prevent interoperability (for example obligations to implement a specific, non-standardised mechanism to register and transfer the GNSS coordinates within an OBU) and they may force service providers to adapt their OBUs to meet such requirements.

In order to better appreciate this issue, the Commission required a detailed analysis across the EU, in particular aiming at:

- developing a general picture of legislation (both at national and EU level) on personal data protection having an impact on electronic toll collection;
- carrying out an analysis on how such legislation has an impact on the technical solutions and how/whether they have impeded cross-border interoperability.

This work was led by our legal expert at CSES, supported by 4iCom. CSES drew upon their expertise in data protection legislation, supported by 4iCom who provided support in terms of their knowledge of the EETS legal framework and of the specific applications in different countries.

A specific question related to data protection issues, as well as the potential impact of the General Data Protection Regulation coming into force in 2018, was included in the questionnaire for the targeted consultation in Task 2.2. Outputs from this question were a key input to Task 1.10, as well as interviews with a number of European data protection authorities as part of Task 2.6, and facilitated through the central contact point at DG JUST (see Section 1.3.6 for a summary of all the interviews carried out as part of Task 2.6).

### 1.2.11 Subtask 1.11: Baseline scenario

The baseline scenario represents the scenario whereby no further action is taken by the EC and the market is left to evolve based on current trends. Assumptions have been made defining the baseline for three key points in time, namely 2016, 2020 and 2025 – thereby allowing us to estimate how the market will progress over the coming decade. Beyond 2025, no further evolution of the market was considered as part of the baseline.

The baseline scenario development draws on the data collected in Tasks 1.2-1.4 in particular and from the Excel-based model developed in Task 1.2, which has been used to estimate the number of vehicles that need to be equipped with OBUs and the number of OBUs needed to travel between country pairs.

The baseline scenario also incorporates a number of assumptions reflecting in particular the evolution in the spread of EETS-compatible tolling across EU markets through time, as well as the likely evolution of technologies used for electronic toll collection in the EU. The assumptions to build the baseline scenario have been developed from desk research, direct enquiries with market players as part of our Task 2.6 consultation, official statistics and expert assumptions, as described below.

#### 1.2.11.1 Assumptions around evolution of OBUs required per origin-destination pair

Whilst the modelling methodology described in Section 1.2.2 above has provided an estimate of the number of OBUs required to travel between each Member State origin-destination pair, these modelling outputs do not include consideration of the presence of any existing interoperable OBUs.

As such, assumptions have been made to estimate the likely impact of these existing schemes on reducing the total number of OBUs required for each origin-destination pair. These assumptions are based on the known existing extent and expansion plans of the coverage of EETS providers who were interviewed as part of Task 2.6 and our own knowledge of market trends. The data collected was incorporated into the modelling assumptions as a percentage of vehicles on each origin-destination pair who already have interoperable OBUs covering their whole journey – thereby contributing towards a weighted average number of OBUs required for each origin-destination pair. These assumptions were prepared for 2016 and adjusted for 2020 and 2025 based on the known expansion plans of EETS providers. A full summary of the assumptions made and with respect to adjusted OBU numbers for each origin-destination pair can be found in the various Tables in Annex A, Section 1.1.

#### 1.2.11.2 Assumptions around cost of OBUs and evolution of types of OBU

Under this approach, two types of technologies have been considered: the first category considers the EETS OBUs, representing the category of interoperable units; the second category considers the national OBUs directly available from toll chargers, and representing non-interoperable units. Assumptions were then made defining how the split between these two types of OBUs at an EU level is likely to evolve through time. Table 1-9 in Annex A displays the assumed evolutions of shares of EETS and national OBUs for the three points in time considered in the baseline in each EU Member State. Note that the splits between EETS OBUs and national OBUs assumed in the baseline are consistent with the adjustments made to OBU numbers described above based on the extent of interoperable EETS provision in different Member States.

In order to account for the split between different types of OBUs as described above, the total estimated number of vehicles that need to be equipped with an OBU calculated in Task 1.2 has been split according to the market shares of EETS and national technologies.

In doing so, two sub-matrices of the number of vehicles travelling between each origin-destination pair are obtained: the number of vehicles that are assumed to be equipped with EETS OBUs and therefore requiring only one OBU to travel between any two pairs of countries; and the number of vehicles that are assumed to be equipped with national OBUs and therefore requiring more than one OBU to travel between any two pairs of countries (with the actual number of OBUs required being based on the matrix of OBU numbers for each origin-destination pair defined in Task 1.2). In parallel, the matrix of the number of OBUs required to travel between each pair of countries has been split into two sub-matrices to reflect the existence of the two technologies<sup>7</sup>.

**Table 1-1: Summary of the cost categories for HDVs per OBU [€/OBU/year]**

Technology	Direct costs	Time losses	Indirect costs	Total costs
EETS OBU	91.95	0.00	55.28	147.23
Percentage (%)	62%	0%	38%	100%
National OBU	35.53	13.51	55.28	104.32
Percentage (%)	34%	13%	53%	100%

Finally, by multiplying the allocation of EETS and national OBUs by the total average unit costs of the two technologies (i.e., €/OBU/year) and comparing the costs for the assumed baseline penetration of EETS OBUs vs. national OBUs against a scenario in which full interoperability is achieved, the impact for road users of the lack of interoperability through time was estimated in the baseline. Note that the average costs of EETS OBUs and national OBUs are assumed to remain constant through time, given the likely upward and downward pressures on pricing, respectively from increasing service fees as EETS providers increase their domain coverage and decreasing equipment costs from economies of scale as more OBUs are deployed.

Regarding cars, OBUs have been assumed to be present only where ETC for private cars is available today (i.e. in Ireland, Italy, France, Portugal and Spain). Cars travelling on international journeys

<sup>7</sup> The sub matrices on the number of OBU per type of technology and pairs of countries has been estimated for the three key points in time in the baseline.

between these countries are assumed in 2016 to require one OBU per country visited (subject to the OBU penetration rates discussed in Section 1.2.2.4 above). The subsequent evolution of the trend in the number of OBUs required per country visited for 2020 and 2025 is inferred from the overall trend in the reduction of OBU numbers for HDVs through time in the baseline.

The costs per OBU estimated reflect the two categories of users assumed and are summarised in the table below<sup>8</sup>. Costs are significantly lower for cars than for HDV users because: a) passenger car OBUs are very simple DSRC-based systems; b) there are no administration costs; and c) there is generally significant competition in the market between multiple service providers.

**Table 1-2: Average costs per OBU for cars**

Item	Commuters	Non-Commuters
Average Costs (€/OBU/year)	15.5	9.1

A full cost breakdown for the costs of both HDV and passenger car OBUs, as well as the various assumptions made in relation to costs, can be found in Tables 1-1 to 1-6 of Annex A.

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<sup>8</sup> The unit costs were identified as an average cost for the countries concerned.

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## 1.3 Task 2: Stakeholder consultation

The stakeholder consultation included a number of subtasks aimed at summarising the outputs of various public engagement exercises, including two targeted consultations (Tasks 2.1 and 2.2 for the 2015 and 2016 targeted consultations respectively), one public consultation (Task 2.3) and a series of unsolicited responses / position papers (Task 2.4). These summary documents, in conjunction with the interviews carried out in Task 2.6, provided valuable inputs into Task 1, the problem definition and modelling the baseline development.

### 1.3.1 Subtask 2.1: Analyse and prepare a summary report of the answers to the targeted consultation which took place during summer 2015

Task 2.1 was aimed at providing a summary of the various responses received from stakeholders as part of the Ex-post Evaluation targeted consultation carried out in summer 2015. Four separate questionnaires covering different areas related to EETS were sent to the following stakeholder groups:

- Heavy-duty vehicle electronic toll users – 2 responses received
- Light-duty vehicle electronic toll users – 1 response received
- Member States and toll chargers – 15 responses received
- Toll service providers – 4 responses received

A total of 22 usable responses were received. A structured Excel spreadsheet was used to draw out the key themes from the responses from different stakeholder categories. We have provided a detailed summary report on the outputs of the consultation by stakeholder category and question in a separate document included in Annex B.

### 1.3.2 Subtask 2.2: Analyse and prepare a summary report of the answers to the targeted consultation on items related to the impact assessment and to the proposal

The targeted consultation in Task 2.2 has been a key source of information and data into the study, particularly as regards identifying the barriers/problems associated with the implementation of EETS across the EU, the root causes of these problems and the potential solutions to these issues.

In the two weeks following the project kick-off meeting, we worked with the Commission to review and provide input to the draft targeted consultation questionnaire prepared by the Commission. This was targeted at the same stakeholders who were targeted with the questionnaires under Task 2.1 in 2015. This time however, it was decided not to prepare a separate questionnaire for each stakeholder group, so a single questionnaire was produced.

Ricardo's consultation experts provided feedback as to how best to structure the questionnaire, for example ensuring:

- That the questions were not too open-ended (thereby avoiding inviting lengthy, unstructured answers which are very difficult to process);
- That the questions were structured in such a way as to draw useful insights in key areas of interest for Task 1, i.e. defining the problem and problem drivers and identifying potential solutions to those problems;
- That the overall questionnaire was not too lengthy, thereby helping to achieve a strong response rate.

Additionally as part of our review of the draft questionnaire, experts from our subcontractors 4iCom and CSES provided a review and additional inputs to the Commission's suggested list of questions, to ensure that the questionnaire was capturing key data points and information that would be of use to the various sub-tasks under Task 1.

The final version of the questionnaire was sent to the Commission on 27<sup>th</sup> September and, following internal approval, it was sent to the relevant stakeholders on 5<sup>th</sup> October, with a deadline for responses of 13<sup>th</sup> November. The full questionnaire can be found in Annex C.

A total of 35 responses were received from the targeted consultation, from a range of stakeholder categories. The outputs from the questionnaires were processed in a similar way to those responses received to the Task 2.1 questionnaire, i.e. using a structured Excel matrix to systematically draw out

the main points from responses to individual questions. We have provided a detailed summary report on the outputs of the consultation by stakeholder category and question in a separate document included in Annex B.

### 1.3.3 Subtask 2.3: Analyse and prepare a summary report of the answers to the public consultation on EETS which will be launched by the Commission

The public consultation was aimed at exploring broader issues associated with the implementation of EETS, rather than the specific issues considered by the targeted consultation in Task 2.2. The consultation closed on 2nd October and a total of 73 responses to the electronic questionnaire were received by that date.

These were provided to us in Excel format and we performed a full quantitative analysis of the breakdown of respondents and of all questions from the questionnaire. In addition to the responses received in Excel, a handful of questionnaire responses (less than five) were received as PDFs. These were incorporated into the Excel spreadsheet prior to the analysis.

We used Excel to create a series of graphs to illustrate the views of respondents (broken down by interest group where relevant). Responses to each question are discussed as part of a summary report following the broad structure outlined in the proposal, with graphs used as context / for illustration and additional commentary provided relating to any free-text responses received. This summary report can be found in Annex B.

### 1.3.4 Subtask 2.4: Analyse and prepare a summary report of the spontaneous contributions to the public consultation provided by stakeholders and citizens

Task 2.4 covers the analysis of spontaneous responses to the public consultation, as well as position papers received by the Commission from various stakeholders on the subject of electronic tolling interoperability. Whilst some of these papers attempt to answer some of the questions from the public consultations, many are relatively lengthy position papers which do not have any clear link to the structure of the public consultation.

A total of 38 contributions were received for Task 2.4, although eleven were of a more general nature and are not covered in detail below, while five were duplicates. Given the unstructured and lengthy nature of these documents, we did not apply the same systematic procedure for analysing the various responses as for Tasks 2.1, 2.2 and 2.3.

Rather, we drew out the key points from the various responses and categorised them by theme, for example drawing out all the points relevant to specific tasks or specific areas/themes (such as standardisation, accreditation, legal barriers, data protection, etc.). The results are presented as a summary document aligned with these themes. The full summary report can be found in Annex B.

### 1.3.5 Subtask 2.5: Reactions to the evaluation roadmap and the inception impact assessment

No responses were received by the Commission under Task 2.5 and as such no analysis was carried out for this task.

### 1.3.6 Subtask 2.6: Identification of additional data needs and direct liaison with stakeholders

The interviews carried out as part of Task 2.6 form a key input to the study covering all of the subtasks in Task 1, as well as providing background knowledge required to feed into the scenario definition in Task 3. We have interviewed a range of stakeholders, covering a broad cross-section of the various experts required to undertake a full review of the problem definition and to provide the data necessary for the modelling required for the Impact Assessment.

The interview programme is now complete. We have reached out to 79 interviewees and carried out 30 interviews, with a further six written responses to the interview questionnaires provided in lieu of interviews. All non-respondents were chased at least once, depending on their importance to the study. A full list of all the interviews carried out and stakeholders contacted can be found in Annex D.

Ricardo coordinated and organised the majority of interviews, with 4iCom taking the lead on interviews with individuals who were well-known to 4iCom. Different members of the team from Ricardo, 4iCom

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and CSES have variously attended the different interviews depending on the particular subtasks which were the focus of the interviews. Interviews were scheduled to last around one hour, to allow sufficient time to gather all the required information. Whilst most interviews were carried out by phone, a number (carried out by 4iCom) were carried out in person.

In order to prepare for each interview, we categorised each interviewee by the specific subtasks we wished to discuss with them and sent them a set of specific questions aimed at each of these subtasks in advance of the interview, in order to provide some structure to the discussion. To this end, interview scripts were developed aligned with each subtasks, as can be seen in Annex E.

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## 1.4 Task 3: Assessment of impacts

The following sub-sections set out an overview of the methodology applied to each of the subtasks under Task 3.

### 1.4.1 Subtask 3.1: Confirmation of policy options

A draft list of policy options was provided in the terms of reference. The study team provided some commentary on the options being considered at the project interim meeting and thereafter, drawing from existing expertise and the knowledge gained in Tasks 1 and 2.

This allowed us to comment on whether the policy options being considered for modelling take account of the revised problem definition from Task 1 and are designed to most effectively address the root causes identified in Task 1.1. The final set of policy options was agreed with the Commission and the study Steering Group conducted their review of the policy options and provided approval. These are summarised in Section 3 below.

### 1.4.2 Subtask 3.2: Screening of impacts

We agreed at the study kick-off meeting that the list of impacts of interest is aligned with that presented in the study terms of reference. In addition to the quantitative impacts on road users, toll chargers and EETS providers, the Commission noted the need to ensure that we cover a number of other economic and social impact categories. This included economic impacts on SMEs and impacts on competitiveness, innovation, and on peripheral Member States, peripheral regions and third countries. In addition the social impacts on employment, the fundamental rights of individuals and organisations, protection of personal data and the right to privacy have also been covered in the ensuing analysis. These various non-quantitative impact categories have been analysed through qualitative, or semi-quantitative approaches, as described in the section below.

### 1.4.3 Subtask 3.3: Development of policy scenarios in the modelling

This task covered the development of the modelling scenarios to be used as part of the main quantitative modelling required from the project. The development of policy options in the model is based on a similar method to that required to develop the baseline scenario, as set out in Sections 1.2.2 and 1.2.11. In order to derive the scenarios for each policy option from the baseline scenario, the assumptions regarding the split of EETS vs. national OBUs per country through time used for the baseline scenario (see the Table 1.10 in Section 1.1.4 of Annex A) were adapted to reflect the extent of EETS expected under each of the three policy options. These new assumptions are based on the following considerations:

- Policy option 1: The self-regulated context of policy option 1 should make the REETS countries (Austria, Denmark, France, Germany, Italy, Poland, Spain and Switzerland (ASECAP, 2015)) more inclined to open their market and offer attractive conditions to EETS providers and should thus boost the penetration rate of EETS providers in these countries. For other countries the situation should evolve in line with the baseline. The current published strategic roadmaps of the various EETS providers are therefore assumed to be realistic for what concerns deployment of EETS in the REETS countries, so penetration rate assumptions for these countries are based on these strategic roadmaps;
- Policy option 2: Using the legislative approach to put into practice the different measures should achieve a more harmonised increase of the penetration rate of EETS in the different EU Member States, leading to both increased extent of EETS and increased interoperability between markets through a greater penetration of EETS OBUs;
- Policy option 3: In the standardisation-based context of policy option 3, the penetration of EETS providers in the different markets should be the same as policy option 2. This is because policy option 2 already achieves the perceived maximum penetration rate for EETS OBU, and therefore policy option 3 cannot exceed this level. The major change in terms of the modelling here is a reduced number of national OBUs<sup>9</sup> and reduced costs for EETS OBUs.

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<sup>9</sup> Currently the penetration rate of national OBUs is quite high in some countries (e.g. Belgium is 90% national OBU and 10% EETS OBU). The expectation is that there will remain a percentage of national OBUs in circulation in 2025. In addition, under policy option 3, a national OBU can also be used in other countries.

The specific assumptions around the split of EETS vs. national OBUs based on the above considerations are summarised for each country in Section 1.3 in Annex A.

On the basis of these assumptions, the origin-destination pair OBU matrices, developed for the baseline scenario for 2016, 2020 and 2025 (see Section 1.3 of Annex A), were updated for each of the policy options, by applying the revised penetration rates for EETS OBUs. In the case of policy option 3, for 2025 we have assumed that only one OBU (whether provided by an EETS provider or a toll charger) would be necessary to travel across the EU, as both the OBUs and the infrastructure of the different countries would be fully standardised and thus all toll domains could be interoperable. The origin-destination pair OBU matrices for each policy option are displayed Section 1.3 of Annex A.

These origin-destination pairs and changes in average OBU costs due to cost savings for EETS OBUs through time and a different proportion of EETS vs. national OBUs through time were inputted into the road user model developed for Task 1.2 to evaluate the total costs to road users under each scenario. The assumptions described above around the extent of EETS penetration in different markets were also used as a basis for evaluating the other quantitative impacts covered by the Impact Assessment.

#### 1.4.4 Subtask 3.4: Assessment of economic impacts

The economic impacts (in particular those related to road users and toll operators / EETS providers) have been in large part estimated from the scenarios set up in the Excel models of impacts on road users and toll chargers and form a key element of the Impact Assessment. We have presented the economic impacts as the difference between the impacts estimated in the baseline and those estimated in each of the scenarios developed in Task 3.3.

##### 1.4.4.1 Impacts on road users

The economic impact on road users (i.e., HDVs and cars) has been estimated starting from the Excel-based model set up to quantify the lack of interoperability of electronic tolls in Task 1.2. It forms a key element of the Impact Assessment.

The economic impact on road users has been quantified in monetary terms as the difference over the time period assumed (i.e.,  $T$ ), between the evolution of the total costs borne in each policy option (defined as a scenario in the model) of the revision of the EETS legislation (i.e.,  $C_i$ ), against the evolution of the total costs estimated in the baseline scenario ( $C_{baseline}$ ). The difference in total costs through time thus estimated has been discounted applying a social discount rate (i.e.,  $i_s$ ) to reflect the societal view on how the future economic impact has to be evaluated in the present.

Finally, the performance of each policy option has been measured in terms of Net Present Value (i.e.,  $NPV_i$ ), which is the performance indicator measuring the absolute welfare gain over the time period considered. The  $NPV_i$  is obtained according to the following equation (EC, 2014)<sup>10</sup>.

$$NPV_i = \sum_{t=0}^T \frac{C_i - C_{baseline}}{(1 + i_s)^t}$$

For the purpose of this analysis, a social discount rate of 4% has been applied, in line with the recommended value from the European Commission's Better Regulation Guidelines.

The calculation of  $NPV_i$  requires knowledge of the total costs for each year within the modelling time period. However in the modelling exercise, inputs and outputs have been defined for three key points in time (i.e., 2016, 2020 and 2025). As such, for the years in between the economic impact have been estimated by linear interpolation.

With respect to the HDVs travelling on international journeys (i.e., trucks and buses), the total costs related to road users for each policy option was calculated from the evolution of (i) the average yearly costs of EETS OBUs and (ii) the estimated number of OBUs (i.e., EETS and national) over time according to market shares. The cost of national OBUs and the number of actual HDVs is assumed to be unchanged over time. Table 1-3 summarises the yearly costs assumed for EETS and national OBUs in the baseline and for each policy option.

<sup>10</sup> European Commission (2014), Guide to Cost-Benefit Analysis of Investment Projects Economic appraisal tool for Cohesion Policy 2014-2020, Directorate-General for Regional and Urban policy, December 2014.



**Table 1-3: Summary of the average yearly costs per type of OBU [€/year]**

Scenario	EETS OBU			National OBU		
	2016	2020	2025	2016	2020	2025
Baseline	147.23	147.23	147.23	104.32	104.32	104.32
Policy option 1	147.23	147.23	123.23	104.32	104.32	104.32
Policy option 2	147.23	123.23	111.23	104.32	104.32	104.32
Policy option 3	147.23	123.23	99.23	104.32	104.32	104.32

The EETS OBU costs reduce over time as increased competition in the market drives down the fees for EETS providers. Furthermore under policy option 3 there is a highly standardised EETS accreditation procedure and very little requirement for adaptation to each market, which provides further downward pressure on prices under normal competition.

With regard to cars, the average costs per OBU are calculated as per the baseline scenario for commuters and non-commuters. This means that we use the same values in terms of OBU costs as for the HDV analysis, so the impact depends on the numbers of OBUs that are sold. The evolution of the trend in the number of OBUs is inferred from the overall trend of OBUs for HDVs though time according to each policy option, as in the baseline.

#### 1.4.4.2 Impacts on toll chargers

For the assessment of impacts on toll chargers for policy option 1 and 2, a measure-by-measure analysis was performed, in order to describe the consequence of each specific measures (or group of measures) associated with each policy option and identify which measure(s) in particular could have direct economic consequences. The two main aspects in that respect were considered to be:

- The additional investments required for updating of the back-office interfaces to comply with the CEN TS 16986 standard (application profile for the ISO 12855 standard);
- The additional investments required for the set-up of a test environment where the different manufacturers may perform pre-compliance verifications with their OBUs.

For policy option 3, we additionally identified which parts of toll chargers' infrastructure would be impacted by the implied standardisation and then evaluated the costs for upgrading or replacing each of them. Four cost items were identified in this respect and priced individually, as follows:

- Roadside equipment on ETC lanes;
- Free-Flow Tolling Stations, for DSRC-based schemes;
- Free-Flow Enforcement Stations, for GNSS-based schemes;
- Back-Office Systems.

Finally, regarding the impact of the policy options on toll evasion, this has been estimated as a percentage of total revenue, based on assumptions around the total impact of toll evasion on revenues, as identified during the consultation in Task 2. The impact is quantified as additional revenue afforded due to the increased means to fight toll evasion, and has been estimated at 1% of total revenue under all policy options.

#### 1.4.4.3 Impacts on EETS providers

The economic impacts on EETS providers stem from the consequences of the policy options in two main respects: the cost borne by EETS providers due to updated accreditation procedures and the additional remuneration they can obtain from toll chargers for the services they provide.

In the case of accreditation procedure costs, we analysed the composition of these costs and identified the cost items which are impacted by the different measures associated with each policy option. Then we evaluated the potential share of savings for each relevant cost item. Finally, we extrapolated the results to provide an aggregated view of the potential savings at the EU-level by making an assumption on the number of accreditation procedures of each kind (GNSS and DSRC) necessary to achieve the assumed EETS providers' penetration rates defined for the OBU O/D matrices of the different policy

option scenarios. To formulate this assumption, we considered three groups of four EETS providers which go through accreditation procedures in respectively: 3 GNSS toll domains and 8 DSRC toll domains (i.e. the group of 4 most ambitious EETS providers); 2 GNSS toll domains and 6 DSRC toll domains (i.e. a group of 4 “intermediate” EETS providers); 4 DSRC toll domains (i.e. a group of “regional” EETS providers).

For the additional remuneration calculation, we based our analysis on our knowledge of the current situation in terms of negotiations between EETS providers and toll chargers, as well as on our view on what could be reasonably included in the scope of this remuneration.

#### 1.4.4.4 Impacts on OBU manufacturers

Impacts on OBU manufacturers have been estimated at a high level based on our approximation of how many OBUs will be required in the baseline and each of the policy scenarios. We estimated total numbers of EETS and national OBUs from the road user modelling and used these numbers as a basis for establishing whether the overall market for OBU manufacturers was growing or shrinking. Additional commentary was also provided on any qualitative impacts from the measures considered.

#### 1.4.4.5 Qualitative assessment of other economic impacts

The qualitative analysis for impacts on innovation, competitiveness, SMEs and on peripheral Member States/third countries were mainly based on our understanding of the EETS market, drawing heavily on the research undertaken in Tasks 1 and 2 of the study. Each measure associated with the various policy options was considered individually with the relative impacts for each impact category assessed for each measure and the various stakeholders affected. The results of this analysis are described in detail in the impacts section below, including innovation impacts (Section 4.1.4), competitiveness impacts (Section 4.1.6), impacts on SMEs (Section 4.1.7) and impacts on peripheral Member States, peripheral regions and third countries outside the EU (Section 4.1.8)

### 1.4.5 Subtask 3.5: Assessment of social impacts

We have described the most important social impacts qualitatively based on our understanding of the issues investigated in Tasks 1 and 2 and the various policy options considered as part of the scenario definition in Task 3.3. Any quantitative element of the analysis (for example for employment impacts) is based on a series of assumptions drawing from literature and the outputs of the modelling of impacts on road users and toll chargers in particular. Further detail is provided below.

#### 1.4.5.1 Employment impacts

It is possible to assess the potential impacts on employment using industry specific employment multipliers. These multipliers use increases and decreases in revenues or costs to estimate the number of potential jobs created. Whilst we have not performed a formalised analysis based on this approach, we have developed some high-level estimates of the overall impact of each policy option on employment, using employment multipliers.

We have additionally produced a more specific analysis of jobs lost as a consequence of the tolling system switching from barriers and/or toll booths to a free flow system under EETS. The impact of these job losses is dependent on the level of automation already in place as many toll booths already have switched to more automated systems via card payments and coin “buckets” reducing the need for toll booth operators to be in toll booths. The roles lost will also be dependent on the degree to which the toll booth operating organisation, as well as the national legislation, is required to retain and redeploy those employees.

Finally, we have produced a basic analysis of the number of jobs created with EETS providers, based on the number of EETS providers and an understanding of their market coverage in 2025, combined with the approximate number of staff required to manage each market from our understanding of EETS operations gained in Task 2.

The resultant number of jobs lost or created for each policy scenario based on the method outline above is discussed in more detail in Section 4.2.1, alongside further qualitative discussion of employment impacts.

#### 1.4.5.2 Qualitative assessments of other social impacts

The qualitative analyses of impacts on the fundamental rights of EU citizens and on the protection of personal data and privacy were mainly based on our understanding of the EETS market, drawing

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heavily from the research undertaken in Tasks 1 and 2. . Each measure associated with the various policy options was considered individually with the relative impacts for each impact category assessed for each measure and the various stakeholders affected. The results of this analysis are described in detail in the impacts section below, including the impact on fundamental rights (Section 4.2.2) and the protection of personal data and right to privacy (Section 4.2.3)

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## 2 Problem Definition

The overall objective of Task 1 was to update the problem definition and develop a baseline against which policy options were compared in Task 3. More specifically, the objectives of Task 1.2 to 1.10, as outlined in the Terms of Reference (ToR) and our proposal for this study, were to provide data to, and inform the update of the problem definition and the baseline design. These subtasks have been completed and summaries of the outputs of these tasks are provided in Sections 2.1 to 2.11. Inputs from stakeholder engagement activities are additionally summarised in Annex B.

### 2.1 Subtask 1.1: Review of problems and problem drivers

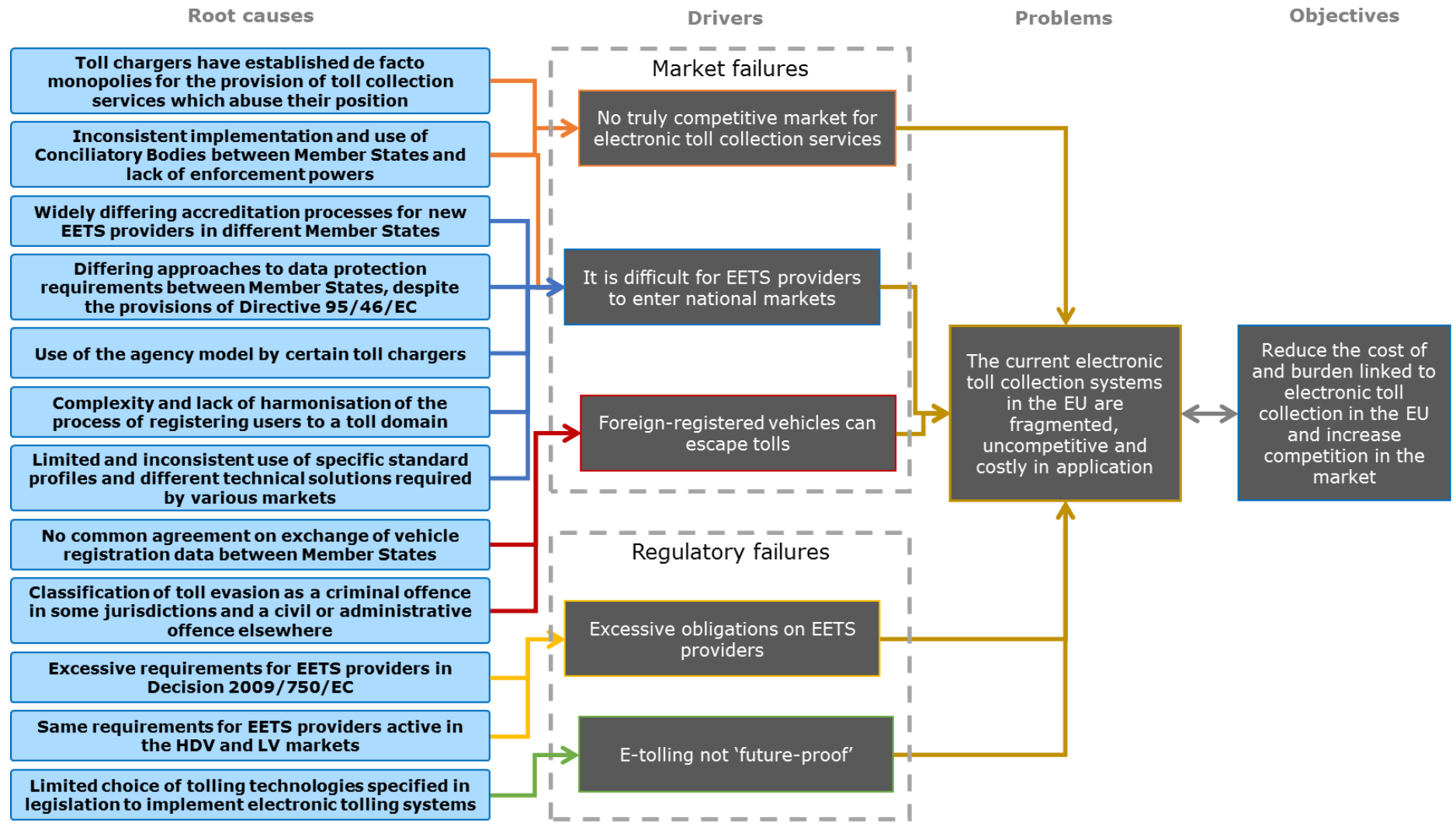
The following sections provide an updated problem definition, which was established on the basis of the findings of Tasks 1.2 - 1.10 and the stakeholder inputs from Task 2. First, the problem tree gives an overview of all problems, their drivers, root causes and resulting objectives. It also provides a useful guide to the subsequent sections that provide the updated problem definition.

#### 2.1.1 Updated problem tree

Based on the research conducted in Tasks 1 and 2, discussions with the DG MOVE project officer and building on the findings of the ex-post evaluation, we reviewed the draft problem tree as presented in the ToR for this study. The updated problem tree is presented overleaf. Compared to the initial version, (as provided in the ToR for this study) the following updates are important to highlight:

- The two problems in the original problem tree have been reduced to a single, over-arching problem which the revised policy options aim to address.
- The drivers have been updated to reflect the additional insights developed from the research in Tasks 1 and 2 and to fit with the revised problem and root causes.
- The root causes have been updated significantly, to provide additional detail as to the individual issues uncovered by the research in Tasks 1 and 2 and to reflect a number of additional issues identified.

Figure 2-1: Updated problem tree diagram



### 2.1.2 What is the nature of the problem?

The main problem identified is as follows: **The current electronic toll collection systems in the EU are fragmented, uncompetitive and costly in application.**

There are around 140 electronic toll collection (ETC) systems in use across the EU and surrounding countries, however despite the introduction of the European Electronic Tolling Service (EETS) Directive in 2004<sup>11</sup> and Decision in 2009<sup>12</sup> aimed at harmonising interoperability across the EU, this market remains largely fragmented. Indeed, a range of technologies (toll gates, free-flow DSRC, GNSS, etc.) and business models are used by different electronic tolling schemes and, whilst a small number of schemes offer cross-border interoperability (for example the scheme covering France, Portugal and Spain for HDVs), the majority do not.

Additionally, despite the 2009 Decision requiring the opening of ETC markets in all Member States to EETS providers, few EETS providers have so far been registered and those that have do not offer coverage beyond a small number of adjacent Member States. Indeed members of AETIS, the EU representative body for EETS providers, consider that the risks associated with offering a service in all Member States is too high, partly due to costly and complex minimum contractual requirements for EETS providers and only partial implementation of EETS legislation in certain markets. Consequently, the existing legislation falls short of its desire to stimulate the development of a fair and competitive market for EETS across the EU.

The result of this fragmented and uncompetitive market is increased costs, both for the road user and for the toll charger. For example, when driving across multiple EU Member States, freight operators are likely to have to purchase or rent multiple On Board Units (OBUs) to communicate with different ETC systems, whilst having an individual contract with each toll operator leads to additional administrative burden. Additionally, the lack of multiple toll service providers in each market stifles competition and promotes higher costs. For toll chargers, fragmentation of the market also increases costs due to the high costs associated with the development, deployment and operation of bespoke tolling systems with bespoke equipment, systems and processes. Limited provisions for recovering unpaid tolls from international road users also result in reduced revenues for toll chargers.

### 2.1.3 Who is (mostly) affected and what is the scale of the problem?

All the main parties in the electronic tolling market are affected by the fragmented, uncompetitive and costly nature of ETC in the EU, including road users, toll chargers and EETS providers.

For **road users**, the main impacts are related primarily to the need to interact with multiple independent toll chargers or toll service providers when travelling across different adjacent EU Member States which have implemented ETC. Given the lack of technological and contractual interoperability between the majority of toll domains in the EU, this creates a requirement for:

- a) Multiple different OBUs to be installed in the vehicle, in order to interact with the roadside infrastructure and/or back office of the toll charger in each relevant toll domain. With each OBU needing to be rented or bought, there is a direct cost associated with this, as well as the indirect costs associated with the installation, maintenance and general management of several OBUs. Additionally, drivers can make errors when manipulating several different OBUs which can lead to non-payment of tolls and consequently high fines.
- b) The vehicle owner to enter into contractual and invoicing arrangements with multiple toll chargers or toll service providers, in order to be able to comply with their respective tolling regulations and pay all tolls due. Here, the vehicle owner will be subject to additional indirect costs associated with having to manage multiple contractual relationships and pay multiple invoices, rather than having a single arrangement covering all the toll domains which their vehicles use.

The total cost to road users of this lack of interoperability due to fragmentation in the European ETC market in the baseline, is estimated from the analysis carried out in Task 1.2 as approximately €60m per year in 2016 for HGVs, €1m for buses and €39m for passenger cars (plus potentially c. €65m of additional costs associated with time losses due to lack of interoperability with national vignette and congestion charging schemes for cars).

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<sup>11</sup> Directive 2004/52/EC ('EETS' Directive)

<sup>12</sup> Decision 2009/750/EC defining the European Electronic Toll Service

Finally, the lack of competition in the market due to the significant barriers to entry for EETS providers entering national markets is also likely to lead to higher costs to road users, as they are forced to use the services of a limited pool of toll service providers (quite often only one) in each market and reduced competitive pressures on existing market players.

For **toll chargers**, the main impacts relate to the need to develop and support bespoke equipment, processes and systems to cover the electronic tolling needs of their toll domain(s), issues related to difficulties in recovering fines from tolls evaded by road users from other Member States, as well as reduced competition for services resulting from the inability of certain EETS providers to enter the market and the complexities of supporting EETS providers' market entry. More specifically, given the lack of technological and contractual interoperability between the majority of toll domains in the EU, the lack of cross-border vehicle registration data sharing and the barriers faced by EETS providers in entering national markets, this leads to:

- a) A requirement for bespoke electronic tolling equipment (i.e. OBUs, roadside units, back-office systems, etc.) able to meet the needs of specific toll domains. Despite the requirements of the EETS legislation stipulating a set of allowable technologies for ETC in the EU, there remains considerable flexibility in these requirements, whilst national implementations of the EETS legislation vary considerably between markets. As such, toll chargers must generally develop specific systems suitable for meeting national legislation (EETS and data privacy legislation in particular) requirements and their own specific needs (i.e. using the right communications technology, data transfer protocols, collecting the required information fields, etc.). Clearly there is a cost associated with the design, development, testing, deployment and support of such bespoke systems and equipment, which could be considerably reduced if standardised systems could be developed or interoperable OBUs used to a larger extent in many different toll domains and countries, due to economies of scale.
- b) A requirement for management of direct relationships with a wide range of account holders. There is also a cost associated with supporting direct relationships with the road users, including the cost of providing customer support / helplines, accounting and invoicing, contract management, etc. Should a centralised EETS provider be responsible for managing these relationships across multiple toll domains, the overall cost per customer could be reduced, in particular because toll chargers don't have the experience and international presence of EETS providers to provide customer services in a cost-efficient manner.
- c) Difficulties in toll chargers recovering unpaid tolls from road users who do not originate in their country of residence. A lack of provisions for sharing vehicle registration data between countries, combined with different treatment of data protection issues and different classification of the legal status of toll evasion between Member States, makes it very difficult for toll chargers to recover fees due across borders. Clearly, there is a cost associated with this, both the direct cost of loss of revenue and the administrative cost of attempting to recover tolls, e.g. through using third party enforcement companies. There is also an issue around foreign-registered vehicles having an unfair advantage over locally-registered ones due to them being less susceptible to toll evasion fines. Indeed, the proportion of toll evaders from foreign-registered vehicles is significantly higher than those from locally-registered vehicles in many markets (see Section 2.4 for further details).
- d) Reduced competition between toll service providers in different toll domains. This reduced choice in selecting providers to supply services can result in higher costs for the toll charger (monopolistic or oligopolistic structure of the market for toll services), as well as a potentially reduced registered user base, thereby potentially resulting in lower toll recovery rates and higher overall costs for the toll chargers.
- e) Complex and very heterogeneous interactions with multiple EETS providers in order to support them in achieving accreditation and registration in the relevant Member State. This in turn can lead to higher costs and a reduced willingness to open the market to new EETS providers, again stifling competition and helping to embed higher costs.

The analysis carried out in Task 1.3 has shown that at an EU-level total operating costs for electronic toll chargers could be reduced by c. €30m per year through widespread technical interoperability of OBUs and an additional c. €100m per year through targeting synergies available from sharing back-office systems across multiple schemes.

For **EETS providers**, the issues faced are varied, including challenging obligations stipulated in the Decision when launching a new service (e.g. the need to cover all EU toll domains within 24 months), differing contractual requirements in different markets and toll domains, unfair competition from existing state-backed service providers, difficulties in ensuring technical and contractual interoperability across different markets, etc. More specifically, heterogeneity and challenging contractual and legal requirements across different markets, combined with weak rights of EETS providers gives rise to:

- a) Difficulties in new EETS providers challenging established EETS providers who may have preferential access to the market and any relevant tender documentation. The fact that various EU toll chargers have established long-term relationships with state-backed or private toll service providers means that the latter are in a very strong position to rapidly grab significant market share, for example if they were previously the monopoly service provider, or if they had been working with the toll charger throughout their system design and tendering process. The result of this is a significant barrier to entry for new EETS providers in many markets, lower available market shares and higher potential costs than their established competitors.
- b) An uneven playing field with respect to the cost of service provision. Whilst the EETS legislation requires toll chargers to offer the same terms to all EETS providers, already-established service providers have lower costs due to the fact they have an established user base, may not need to invest in developing and accrediting new technology and processes to adapt to the local tolling market, may offer to their clients State-subsidised OBUs and may not need to be simultaneously investing in multiple markets. As a result, offering the same terms to all EETS providers can lead to new entrants being at a significant disadvantage to well-established local players, again creating a significant barrier to entry and leading to potentially higher costs.
- c) Costly and complicated compliance with EETS contractual requirements. For example, the requirement for EETS providers to cover all EU toll domains within 24 months of launch is a hugely challenging task, requiring negotiations in dozens of toll domains with multiple parties, design and testing of equipment for interoperability in all the relevant domains and accreditation in multiple Member States. To add to this, the accreditation processes vary widely between Member States, all of which adds significantly to the cost and complexity of EETS provision.
- d) An inability to challenge the status quo, or to defend their rights effectively in new markets. Whilst the EETS legislation requires the creation of Conciliation Bodies in each market to preside over and rule on any disputes occurring between EETS providers and toll chargers, the implementation of these Conciliation Bodies varies between Member States and their enforcement powers are limited. There are some questions about the impartiality of Conciliation Bodies in different Member States, whilst uncertainties around whether they can intervene only after an EETS provider is registered in a particular Member State results in even greater difficulties for potential EETS providers defending their rights at an earlier stage of market entry. Finally, even if a decision is made in favour of a particular EETS provider, the Conciliation Bodies only have conciliatory powers and therefore cannot enforce this decision. Again, the result is potential difficulties in EETS providers challenging any remaining unfair practices or barriers to entry in specific Member States, thereby potentially leading to lower market shares and increased costs.

#### 2.1.4 How has the problem developed over time?

The use of electronic toll charging (ETC) for heavy duty vehicles (HDVs) in the EU is widespread and continues to expand: for example OBU-based ETC is the only available toll collection method in eight Member States (Austria, Belgium, Czech Republic, Germany, Hungary, Poland (ViaToll), Portugal, Slovakia), whilst in other countries with network-wide electronic tolling systems (i.e. Croatia, France, Greece, Ireland, Italy, Slovenia and Spain) both manual and electronic tolling are available.

However, despite this increasing prevalence of electronic tolling and the fact that most ETC systems are largely interoperable between different toll domains within most Member State, only a limited number of cross-border interoperability agreements have been reached<sup>13</sup> since the introduction of the

<sup>13</sup> •**Austria / Germany**: One-way technical interoperability agreements between Austria and Germany, and between Austria and Switzerland. In both cases, interoperability works one way only, and is limited to technical interoperability, with no contractual interoperability available.

•**Agreements between toll domains using the DSRC technology**: Since 2013, it is possible to pay tolls with one OBU in Norway, Sweden, Denmark and Austria (EasyGo+ agreement). Initially developed on the basis of a pure agreement between toll chargers, the system is now evolving to allow independent toll service providers to offer their services in the area. Thanks to this evolution, providers already active in France, Spain, Portugal and Italy could start negotiating access to the service. If these negotiations are successfully concluded, it will soon be possible to



Directive in 2004 and the Decision in 2009. Whilst the situation has improved somewhat since the introduction of the legislation (with all new systems taking account of its requirements and the Austrian system taking remedial action to ensure compliance with the legislation), new systems coming online continue to suffer from the same loose specification of standards, widely differing accreditation processes and difficulties in recovering unpaid tolls across borders. As a result, despite being 'compliant' with the legislation, the majority of new systems have limited opportunities for full technical, procedural and contractual cross-border interoperability.

With regards to EETS providers' entry into national markets, added to the difficulties in achieving cross-border interoperability, approximately half of the EU Member States have not yet correctly or fully implemented EETS requirements to completely open their markets to EETS providers (European Commission, 2016). This creates additional barriers to entry and an uneven playing field for new market entrants, thereby contributing to the very slow progress that EETS providers have made to date in entering the European ETC market. Indeed, whilst several toll service providers operating within only one Member State have reorganised themselves along the EETS model in recent years, only a handful of registered EETS providers with interests in multiple markets have emerged (European Commission, 2016): AGES was registered in Germany in April 2015, but does not plan to start operations due to an unclear business case in Germany; Axxès was registered in January 2016 and operates in five countries (Belgium, France, Germany, Portugal, Spain) including both those that require EETS registration to operate (Belgium, Germany), but only in four (Belgium, France, Portugal and Spain) does it operate in all toll domains; in particular in Germany it only operates on the small toll domain of the Herrentunnel, but not on the wider motorway network; Telepass, Eurotoll and Total were registered recently and are interoperable in several countries that do not mandate EETS registration for operations, but are not yet accredited in Belgium or Germany.

For light vehicle users, electronic tolling is available on significant parts of the road networks in Croatia, France, Greece, Ireland, Italy, Poland, Portugal and Spain. In most of these tolling schemes, users can choose between electronic tolling requiring OBUs and manual payment at the toll booths. Whilst systems are largely interoperable across different toll domains within most Member States (e.g. the TIS-VL (branded as Liber-T) agreement allows users to pay tolls on all tolled motorways in France with one OBU and one invoice), only limited cross-border interoperability is available, usually between toll domains either side of a common international border, e.g. the TIS-VL OBU doesn't offer cross-border interoperability, even if though the TIS-certified OBU used could in theory be used on French, Portuguese and Spanish toll domains and even in the Liefkenshoek tunnel in Belgium (some, but not all Liber-T providers offer OBUs which can be used in neighbouring regions of Spain).

### 2.1.5 What are the drivers and root causes of the problem?

#### **Driver 1: No truly competitive market for electronic toll collection services**

There are two main root causes of the uncompetitive ETC market in the EU, including:

- *Toll chargers have established de facto monopolies for the provision of toll collection services which abuse their position.* In some Member States, the presence of vertically integrated toll chargers and toll service providers, or the presence of well-established national toll service providers can present a potential barrier to entry to toll chargers. For example, a number of EETS providers applying for accreditation in Belgium have complained that the national toll service provider Satellic had unfair access to the toll chargers' representative ViaPass during the national system design and early tendering phase, thereby allowing Satellic to streamline its accreditation and design its OBUs to match the specification of the planned ETC system earlier than other toll service providers (e.g. Axxès) and thereby to have an unfair first mover advantage in accessing Belgian tolling customers. Another example is in Germany, where the national service provider TollCollect is seen to have an unfair advantage over other potential EETS providers, given that there is no provision in national law to remunerate toll service providers other than TollCollect (even if they are registered as EETS providers), thereby presenting an unsurmountable barrier to entry in the German market for many potential EETS

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travel on the toll roads of all eight countries – all using the DSRC technology – with one OBU issued by third party toll service providers and a single monthly invoice.

•**Hungary:** the electronic tolling system in this country is technically ready to connect to third party toll service providers. Despite the Hungarian system being operational since 2013, so far no toll service providers from abroad have entered the market.

•**Belgium:** The Belgian system was launched on 1 April 2016. Several third party providers, including Axxès which already provides its services in France, Spain and Portugal, have negotiated access to the market.

providers. This root cause makes it very difficult (and sometimes impossible) for EETS providers to enter certain Member State markets in competition with well-established, sometimes state-backed, quasi-monopoly-holders. The result is a lower level of competition in the European ETC market than might otherwise be the case if free and fair access was provided to all national tolling markets.

- *Inconsistent implementation and use of Conciliation Bodies between Member States and lack of enforcement powers.* As part of setting out the rights and obligations of the various parties in the EETS system, the Decision required Member States to establish Conciliation Bodies to supervise the correct application of the rights and obligations of all parties, in particular to resolve any potential disputes between toll chargers and EETS providers. However Articles 10 and 11 which define the Conciliation Bodies do not provide sufficient clarity on who can access the Conciliation Body (e.g. can a non-registered or accredited EETS provider challenge any barriers to entry prior to entering into expensive accreditation procedures), nor do they provide the Conciliation Body with any binding powers to enforce their decision. Issues associated with accreditation are discussed in more detail in Section 2.8 below. This root cause puts EETS providers in a very weak position to challenge any significant barriers to entry presented by the accreditation and registration process, or any preferential treatment being given to local market players. This again presents a significant potential barrier to entry to EETS providers looking to enter new markets and could lead to a smaller accessible market, lower profits and higher overall costs if they are not able to enforce a negotiated/mediated solution. Ultimately this leads to fewer active EETS providers in national markets and a less competitive market for road users and toll chargers.

**Driver 2: It is difficult for EETS providers to enter national markets**

There are five main root causes of the difficulty which EETS providers face when entering new markets, including:

- *Widely differing accreditation processes for new EETS providers in different Member States.* All EETS providers must undergo accreditation in each market that they wish to provide their services to, as defined in Annex IV of the Decision. However, the accreditation procedures vary widely between markets, with significant variations in timeline (from 6 to 18 months), cost, procedures and technical requirements. These issues are discussed more fully in Section 2.1.8 below. As a result of this root cause, prospective EETS providers trying to enter new markets can be presented with a significant barrier to entry in certain markets, leading to a more fragmented and smaller accessible market for them, therefore contributing to reduced potential profitability and to them deciding not to try to enter certain markets.
- *Differing approaches to data protection requirements between Member States, despite the provisions of Directive 95/46/EC.* Whilst Directive 95/46/EC sets out a framework under which Member States should protect personal data in the EU (to be replaced by the General Data Protection Regulation – GDPR in 2018), this Directive has been transposed into national legislation varyingly, with some Member States (e.g. Germany) imposing more restrictions on how the data can be used. This can lead to a number of issues, for example inconsistency between the data fields that are required to be collected by toll chargers in different Member States, or different rules about where/for how long GPS location data can be stored and processed, etc. These issues are explored in more detail in Section 2.10 below. The net result of these differing approaches to data protection is that achieving technical interoperability between multiple markets is more difficult, given the need to take account of differing rules in different Member States. Again, this creates an additional barrier to entry to EETS providers and increases their market entry costs.
- *Use of the agency model by certain toll chargers.* Where national or local legislation classifies tolls as taxes the toll operator becomes in effect a tax collector. In these circumstances the EETS provider is regarded as a collection agent, i.e. they must adopt the ‘agency model’. On the other hand, where tolls are not classified as taxes the toll represents payment for a service and the EETS provider can be regarded as simply as a sub-seller. One important practical consequence of this distinction is that where tolls are collected as taxes, in principle no VAT is payable, whilst the EETS provider cannot issue an invoice directly to the road user, thereby adding complexity to the billing process. The contrary is the case in the reseller model. Some EETS providers have reported that, depending on the way the Payments Service Directive is implemented in a given Member State, the EETS provider might be even required to have a

banking licence to be allowed to collect tolls under the agency model (this is reported to be the case for toll service providers established in Germany). These issues are explored in more detail in Section 2.8.1 below. The different treatment of toll fees from a tax perspective can create significant difficulties in designing a common business model (and billing system) to operate in any toll domain in the EU, thereby adding complexity and cost to any prospective EETS provider looking to serve the EU market.

- *Complexity and lack of harmonisation of the process of accrediting users to a toll domain.* Whilst Articles 3 and 4 of the Decision set out the requirements, rights and obligations of EETS providers, Article 6 of the Directive sets out the need for Member States to transpose the requirements of the Directive into national laws. However, the generally loose wording and non-specific nature of many of the provisions included in both the Directive and Decision mean that these have been interpreted differently by different Member States, as described in several of the above points. Indeed in several cases, domain statements have not yet been (fully) published by Member States. As a result of this root cause, heterogeneous and sometimes unclear registration procedures are in place for EETS providers in different Member States, with additional complexities emerging in some markets (e.g. two Member States distinguishing between “discrimination *between*” or “discrimination *of*” EETS providers (European Commission, 2016)). The result is a more uncertain market for EETS providers, potentially throwing up unexpected barriers to entry and/or additional costs as they attempt to enter new markets.
- *Limited and inconsistent use of specific standard profiles and different technical solutions required by different markets.* Whilst the 2004 Directive defines three main technologies that can be used for electronic toll collection under Article 2, it and Annex III of the Decision only reference a limited set of standards to define the specific mechanics of implementation with regards to DSRC-based systems, autonomous (GNSS) systems and the various back-office systems and processes required. Whilst some additional standards are referenced in the accompanying EETS implementation guidance documents, in most cases these standards are broad ‘toolbox’ standards which provide much flexibility for interpretation and are not appropriate for ensuring rigid interoperability requirements. Despite the fact that a suite of specific ‘profile’ standards do exist to more fully define a more rigid implementation of EETS, these are not referenced in the Legislation. As such, different technical solutions are adopted in different EETS domains and, whilst they may conform to the broad standards and technological choices referenced in the Legislation, sufficient differences (e.g. differences in the exact list of data that must be transmitted for a transaction to take place) occur between markets to prevent technical interoperability with the OBUs of different EETS providers, which are often designed with their primary market in mind. Even where interoperability is possible, the subtle differences between markets make it more complex and lengthy for EETS providers to achieve accreditation. Finally, standards are constantly evolving due to the evolution of technologies and the governance process for updating the standards relevant to EETS is not entirely clear and, as such it may be difficult to accommodate updated standards as they become available to ensure effective backward and forward compatibility. These issues are discussed more fully in Section 2.7 below. The overall result of this root cause is that the technical solutions developed for different domains vary between markets, with subtle differences in interpretation of the referenced standards leading to a lack of cross-border interoperability and a barrier to EETS providers entering new national markets using standardised equipment.

### **Driver 3: Foreign-registered vehicles can escape tolls**

There are two main root causes of the unfair advantage that foreign-registered vehicles have in being able to escape unpaid tolls or fines due, specifically:

- *No common agreement exists regulating the exchange of vehicle registration data between Member States.* Whilst a small number of Member States have agreements in place allowing for the exchange of vehicle registration data across borders, and the pursuit of unpaid tolls by authorities (for example the agreement between Germany and Austria), most Member States do not have such agreements in place and no common pan-EU agreement exists such as the Cross Border Enforcement Directive (2011/82/EU) for road safety traffic events. These issues are discussed more fully in Section 2.4 below. As a result of this root cause, recovering unpaid tolls across borders is a complex, and sometimes impossible task for toll chargers – resulting

in lower toll recovery rates and higher overall costs to toll chargers, but more importantly in an unfair advantage for foreign-registered vehicles who are much more likely to escape toll or fine recovery efforts.

- *Classification of toll evasion as a criminal offence in some jurisdictions and a civil or administrative offence elsewhere.* Tax authorities may treat EETS toll fees differently, for example some treating them as a tax, whilst others treat them as a service fee. There are a number of impacts from this differing treatment, one of which is related to the ability to share vehicle registration data across borders. For example, whilst tax evasion may be treated as a criminal offence warranting the sharing of data across borders in some jurisdictions, some authorities treat the recovery of tolls as an administrative or civil issue, which may not qualify for sharing of data across borders. To add to this complexity, different Member States have interpreted the EU Data Protection Directive (95/46/EC) and its successor the General Data Protection Regulation (GDPR) differently and therefore have different requirements for sharing data across borders. These issues are discussed more fully in Section 2.9 below. As a result of this root cause, there are myriad complexities associated with recovering unpaid tolls across borders both within the EU and with neighbouring countries – again contributing to an unfair advantage for foreign-registered vehicles.

#### **Driver 4: Excessive obligations on EETS providers**

There are two main root causes affecting the lack of technical, procedural and contractual interoperability, specifically:

- *Excessive requirements for EETS providers in Decision 2009/750/EC.* The Decision sets out a range of requirements, rights and obligations that EETS providers must achieve in order to be officially registered and operate, under Articles 3 and 4. This includes both some very stringent requirements, such as the requirement to cover all EU toll domains (over 140 domains) within 24 months of registration, or the need to guarantee the quality and continuity of EETS. In addition to this, the Decision included some poorly-defined requirements which can be interpreted in different ways by different national registering authorities, such as the need to support toll chargers in recovering tolls, or to prove “appropriate financial standing” and a “global risk management plan” (European Commission, 2016). These issues are discussed in more detail in Section 2.5 below. When taken together, these stringent and poorly-defined requirements for EETS providers can be excessive and present a significant barrier to entry to new market entrants, adding cost and complexity to any prospective EETS provider considering registration.
- *Same requirements for EETS providers active in the HDV and LV markets.* There are intrinsic differences between the European tolling markets for light and heavy vehicles. EETS providers tend to specialise in one or the other market. For instance, all members of AETIS specialise in the provision of toll services to HDVs and are not interested in offering similar services to LDVs. However, the EETS Directive provides in its article 2.2 that “operators shall make available to interested users on-board equipment which is suitable for use with all electronic toll systems in service in the Member States using the technologies referred to in paragraph 1 [satellite positioning, mobile communications using the GSM-GPRS standard and 5.8 GHz microwave technology] and which is suitable for use in all types of vehicle [...]”. This provision may be interpreted as requiring: a) that each EETS provider services all types of user rather than only heavy or only light vehicles; and b) that each EETS provider must service light vehicles with GNSS-based OBUs even though no satellite tolling schemes exist in Europe for such vehicles. These requirements could act for some companies as a disincentive to enter the EETS business, and in any case certainly adds to the lack of clarity of the rules in place. This root cause therefore potentially acts as an additional barrier to entry to new EETS market entrants considering registration.

#### **Driver 5: ETC is not ‘future-proof’**

The main root cause leading to ETC’s poor ‘future-proofing’ is the *limited choice of tolling technologies specified in legislation to implement electronic tolling systems*. The 2004 Directive defines three main technologies that can be used for EETS provision under Article 2, i.e. DSRC-based (two technologies, including the standard used in Italy) and GNSS-based systems. However, other technologies can potentially be used for ETC services, such as radio-frequency identification (RFID). Furthermore, as technology evolves, particularly in the context of connected and autonomous vehicles, other potential

future solutions may emerge which could facilitate ETC in the EU. Given the restrictive definition of available technologies for EETS, it may be difficult for alternative or newer, potentially more cost-effective solutions to be developed within the European electronic tolling framework and the overall result of this root cause is a potential lack of future-proofing for EETS going forward, amidst a constantly evolving technical and standards landscape. These issues are discussed further in Sections 2.6 and 2.70 below. However, whilst there is a need for flexibility in the Legislation to ensure that systems are designed to be future-proof, it is essential that this is done in a managed way to prevent further divergence in the technical solutions adopted and even poorer interoperability going forward. Here the governance process for updating the technologies and standards relevant to EETS should be clarified, to ensure that all viable and mature technical solutions are considered whilst ensuring effective backward and forward compatibility.

### 2.1.6 How is it expected to develop without new EU action?

A number of EETS providers have developed roadmaps stating their intentions to cover additional markets by 2020<sup>14</sup>, however in many cases they may encounter barriers caused by the various complexities described above around the lack of harmonisation of technologies and national legislation, as well as the lack of a level playing in certain markets, varying technical, contractual and procedural specifications and sometimes complex and heterogeneous accreditation procedures between Member States.

Without further EU action, it is likely that several Member States will retain different interpretations of the legislation and will not fully open their markets to EETS providers, as was the original intention of the Directive and Decision. This is likely to result in a market that remains fragmented and regional in nature, with limited interoperability available between key adjacent markets and interoperability offered on a varying basis between contractual and technical interoperability.

### 2.1.7 Why is action required at the EU level?

This problem is by its nature a pan-European problem, whereby ensuring interoperability for ETC across the EU requires action that involves all EU Member States. Whilst some Member States have fully opened their markets to EETS providers, for varying reasons others have not, whilst other market barriers remain, as described above. Even those Member States with fully open markets have interpreted various aspects of the requirements of the legislation differently and therefore retain some barriers to entry, particularly for EETS providers who have initially focused their market entry activities elsewhere. The result is a series of barriers to entry, varying market-to-market, making ETC service provision in the EU costly, uncompetitive and burdensome.

Given vested interests in certain Member States, who are likely to provide significant inertia to any change, and the fragmented nature of other ETC markets, this problem requires action that forces all EU Member States to act and to provide a level playing field for EETS providers. The only realistic way to ensure that action is enacted by all EU Member States (without needing to coordinate between 28 national Governments and other stakeholders in 28 Member States) is for action to be taken at the EU level. This will help to ensure that the problem is reduced and eventually solved.

## 2.2 Subtask 1.2: Quantify in time and monetary terms the cost and hassle caused to road users by the lack of interoperability of electronic tolls in the EU and close neighbours

The total costs for quantifying the impact for road users due to the lack of interoperability of electronic tolling in the EU have been assessed using the Excel-based model and baseline developed in Tasks 1.2 and 1.11, respectively. The structure of the Excel-based model and baseline assumptions have been presented in Sections 1.2.2 and 1.2.11 respectively.

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<sup>14</sup> These roadmaps are generally confidential and therefore cannot be disclosed, although some information is available from the REETS Cross-Border Deployment Plan, available here: [http://eetsinfoplatform.eu/index.php?option=com\\_best\\_practice&view=bestpractices&Itemid=145](http://eetsinfoplatform.eu/index.php?option=com_best_practice&view=bestpractices&Itemid=145). This information and information from our interviews with EETS providers have been aggregated and anonymised as part of our baseline assumptions for the evolution of EETS interoperability through time. Table 1-9 in Annex A provides an overview of the expected penetration of interoperable OBUs in the major EU markets based on discussions with various EETS providers as part of the Task 2.6 interview programme.

In estimating the costs borne by the users, priority has been given to HDVs (i.e., HGVs and buses) and a less detailed assessment has been developed for cars.

### 2.2.1 Costs for HGVs

Regarding HGVs, results are provided separately for EU hauliers and foreign hauliers, the latter of which have been assumed as the sum of three components (i.e., EEA, Western Balkans and other countries)<sup>15</sup>. The estimation of the total costs is provided broken down by three categories of costs (i.e., direct, time losses and indirect). Table 2-1 provides a summary of the results obtained for HGV road users.

**Table 2-1: Summary of baseline costs (€/year) to HGVs for using road tolling infrastructure**

Category of hauliers	Estimated number of HGVs involved	2016	2020	2025	Full interoperability
<b>EU</b>	<b>888,345</b>	<b>187,021,346</b>	<b>177,852,579</b>	<b>171,255,631</b>	<b>130,791,014</b>
<b>Non-EU</b>	<b>35,952</b>	<b>9,004,288</b>	<b>8,484,662</b>	<b>8,116,616</b>	<b>5,293,249</b>
Switzerland	8,998	2,045,282	1,953,475	1,891,654	1,324,843
EEA	6,264	1,371,446	1,300,154	1,260,604	921,413
Western Balkans	5,649	1,137,778	1,101,729	1,072,773	831,720
Other countries	15,046	4,449,783	4,129,304	3,891,585	2,215,273
<b>Total</b>	<b>924,297</b>	<b>196,025,635</b>	<b>186,337,241</b>	<b>179,372,247</b>	<b>136,084,263</b>
of which EETS OBUs		31,404,728	42,304,272	55,260,172	136,084,263
of which national OBUs		164,620,906	144,032,969	124,112,074	

Regarding the provenance of hauliers, the outputs produced show that the large majority of vehicles are registered in EU Member States (c. 96%). With respect to the total costs borne, the share of users from EU Member States remains around 96% through time. Based on the progression of EETS compatibility / interoperability assumed in the baseline, the total costs of accessing road tolling infrastructure for EU road users reduces through time, by 5% from 2016 to 2020 and by 8% from 2016 to 2025. In absolute terms, the total cost reduction through time is equal to €60m per year, or approximately €65 per vehicle.

With respect to the quantification of the cost of lack of interoperability of electronic tolling for road users, this can be inferred by comparing the total costs estimated for the three points in time, against the total costs assuming full interoperability (i.e. vehicles on each origin-destination pair being equipped with interoperable OBUs covering the whole journey). Thus, the total cost of the lack of interoperability for road users (including the assumed expansion plans for the coverage of EETS providers through time) in 2016, 2020 and 2025 are €60m, €50m and €43m per year respectively.

Figure 2-2 shows the split between costs associated with EETS and national 2 OBUs through time. Whilst the costs for (more expensive) EETS OBUs increase significantly as the number of interoperable OBUs on the market grows, the total costs reduce because of the significant reduction in the number of national OBUs. The modelling outputs show that the pace of reduction of the total costs of national OBUs is approximately twice the pace of the increase of the costs of EETS OBUs.

<sup>15</sup> Due to the lack of data sources for some of the countries considered, analytical assumptions were made that took into consideration the general trend of the countries belonging to the same group classification, i.e. EEA, Balkans, etc. Further information has been drawn from national statistics of Norway (<http://www.ssb.no/en>), national statistics of Switzerland (<https://www.bfs.admin.ch>), Statistical Office of Republic of Serbia (2015) Total transport of passengers and goods and TRT, DIW ECON, ICF (2014), Study on the economic impact of an agreement between the EU and the Republic of Turkey.

Figure 2-2: Baseline annual costs to HGVs for using road tolling infrastructure, by OBU technology type

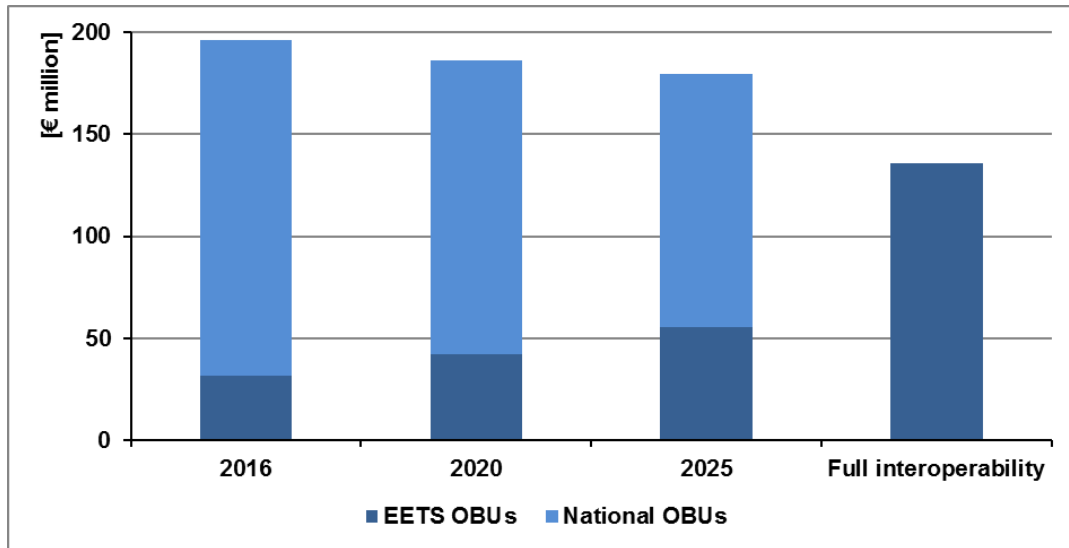
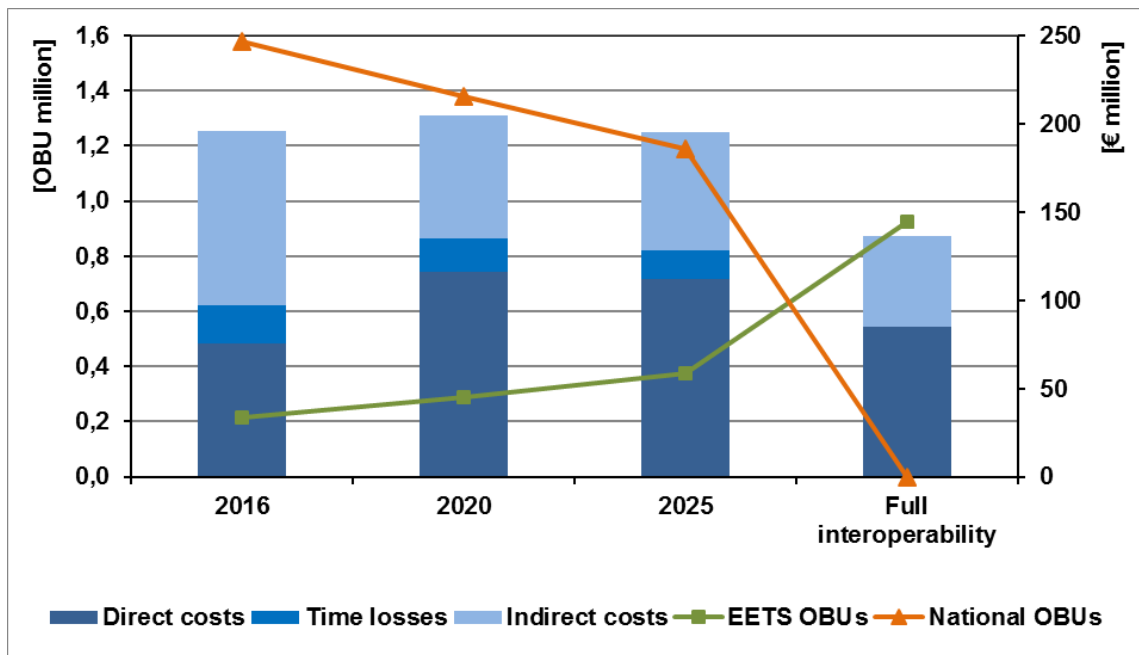


Figure 2-3 illustrates (i) the trend in costs by cost category, showing a rapid reduction in indirect costs and time losses as the total number of OBUs (and associated contracts and hassle) decreases due to increased interoperability and (ii) the trends in the total numbers of OBUs for both types. The trend for direct costs is U-shaped, illustrating that whilst costs initially rise due to the more expensive EETS OBUs being deployed, the reduction in the total number of OBUs eventually outweighs the increased unit costs when switching from EETS to national OBUs.

Figure 2-3: Baseline annual costs to HGVs for using road tolling infrastructure, by cost category



### 2.2.2 Costs for buses

Regarding regular bus services, the results obtained from the assessment are presented in Table 2-2. The outputs produced show that the large majority of buses are registered in EU Member States (c. 63%). With respect to the total costs borne, the share of buses from EU Member States remains around 63% through time. Based on the progression of EETS compatibility / interoperability assumed in the baseline, the total costs of accessing road tolling infrastructure for EU buses reduces through time, by 5% from 2016 to 2020 and by 11% from 2016 to 2025. In absolute terms, the total cost reduction through time is equal to €0.8m, or approximately €69 per bus.

With respect to the quantification of the cost of lack of interoperability of electronic tolling for buses, this can be inferred by comparing the total costs estimated for the three points in time, against the total costs assuming full interoperability (i.e. vehicles on each origin-destination pair being equipped with interoperable OBUs covering the whole journey). Thus, the total cost of the lack of interoperability for buses (including the assumed expansion plans for the coverage of EETS providers through time) in 2016, 2020 and 2025 are €0.8m, €0.7m and €0.6m, respectively. As expected given the much lower number of vehicles involved (c. 11,000 for buses compared to c. 920,000 for HGVs), the costs of lack of interoperability for buses are much lower than those for HGVs.

Figure 2-4 shows the split between costs associated with EETS and national OBUs through time. Similarly to the results obtained for HGVs, the cost for EETS OBUs increases significantly, but the total cost reduces given the decrease of the number of national OBUs.

**Table 2-2: Summary of baseline costs (€/year) to buses for using road tolling infrastructure**

Category of buses	Estimated number of buses involved	2016	2020	2025	Full interoperability
<b>EU</b>	<b>7,003</b>	<b>1,627,034</b>	<b>1,541,437</b>	<b>1,455,206</b>	<b>1,023,699</b>
<b>Non-EU</b>	<b>4,187</b>	<b>498,139</b>	<b>475,609</b>	<b>459,055</b>	<b>326,829</b>
<i>Switzerland</i>	499	130,655	124,251	117,885	68,397
<i>EEA</i>	130	26,229	24,898	24,211	18,732
<i>Western Balkans</i>	3,220	275,416	262,991	255,392	191,232
<i>Other countries</i>	338	65,839	63,469	61,567	48,468
<b>Total</b>	<b>11,190</b>	<b>2,125,173</b>	<b>2,017,045</b>	<b>1,914,261</b>	<b>1,350,528</b>
<i>of which EETS OBUs</i>		192,865	327,667	488,219	1,350,528
<i>of which national OBUs</i>		1,932,308	1,689,378	1,426,042	

**Figure 2-4: Baseline annual costs to buses for using road tolling infrastructure, by OBU technology type**

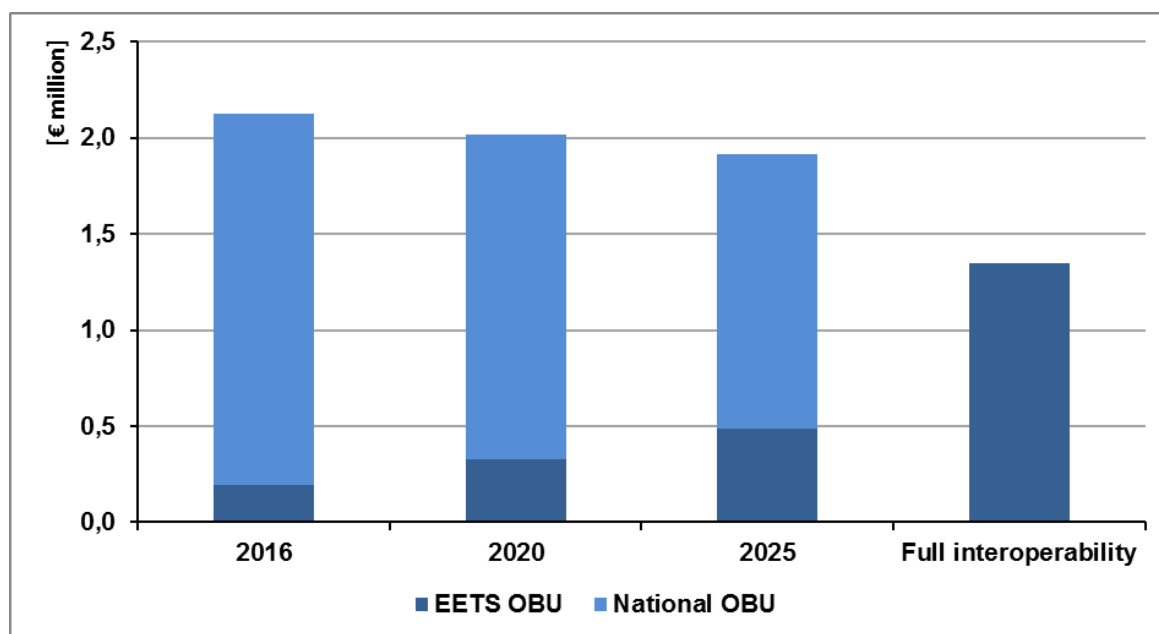
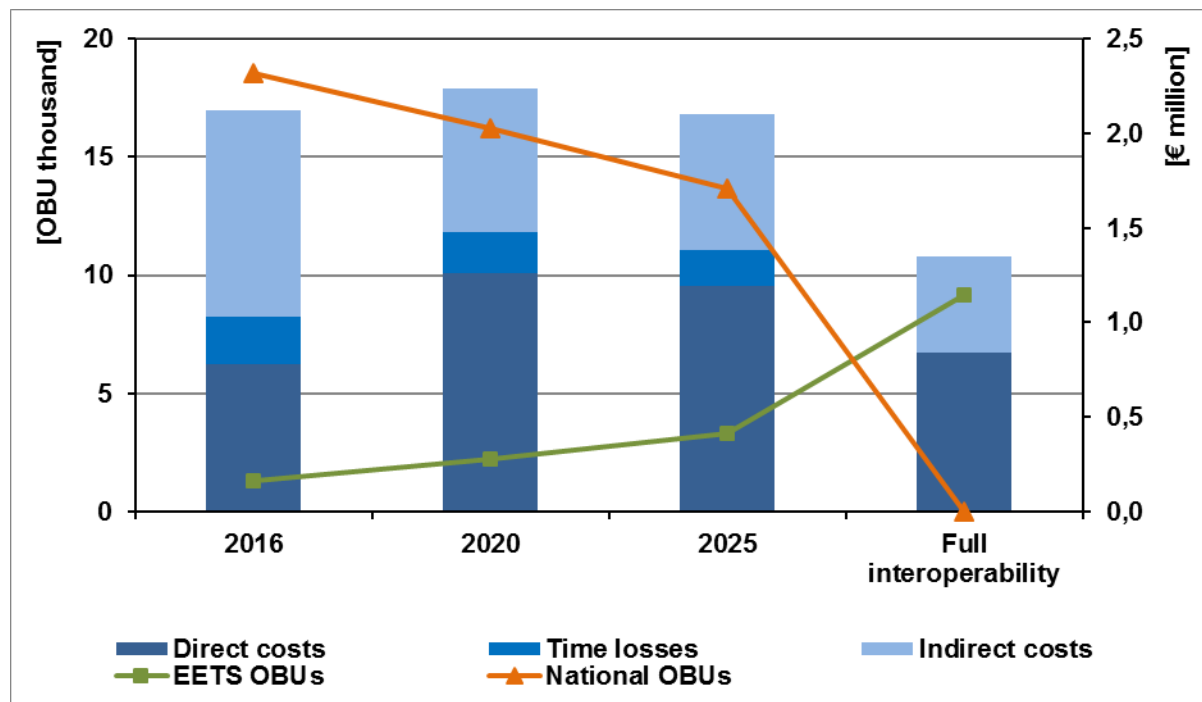




Figure 2-5 illustrates (i) the trend in costs by cost category, showing a reduction in indirect costs and time losses as the total number of OBUs (and associated contracts and hassle) decreases due to increased interoperability and (ii) the trends in the total numbers of OBUs for both types. As in the case of HGVs, the trend for direct costs is U-shaped, again illustrating that whilst costs initially rise due to the more expensive EETS OBUs being deployed, the reduction in the total number of OBUs eventually outweighs the increased unit costs when switching from EETS to national OBUs.

Figure 2-5: Baseline annual costs to buses for using road tolling infrastructure, by cost category



### 2.2.3 Costs for passenger cars

Regarding passenger car road users, the results obtained from the modelling are presented in Table 2-3 and Figure 2-6 below, split by the two main categories of commuters and non-commuters.

Table 2-3: Summary of baseline costs (€/year) to passenger cars for using road tolling infrastructure

Category of trips	Estimated number of vehicles involved	2016	2020	2025	Full interoperability
Total Commuters	324,631	4,510,349	4,408,035	4,382,680	2,524,332
EU	293,465	3,858,556	3,756,241	3,730,886	2,044,056
Non-EU	31,166	651,794	651,794	651,794	480,277
Total Non-Comm.	6,121,452	70,523,262	65,352,186	64,355,812	30,691,742
EU	5,435,218	61,653,898	57,190,479	56,194,106	25,891,870
Non-EU	686,234	8,869,363	8,161,706	8,161,706	4,799,872
<b>Total</b>	<b>6,446,083</b>	<b>75,033,611</b>	<b>69,760,220</b>	<b>68,738,492</b>	<b>33,216,075</b>

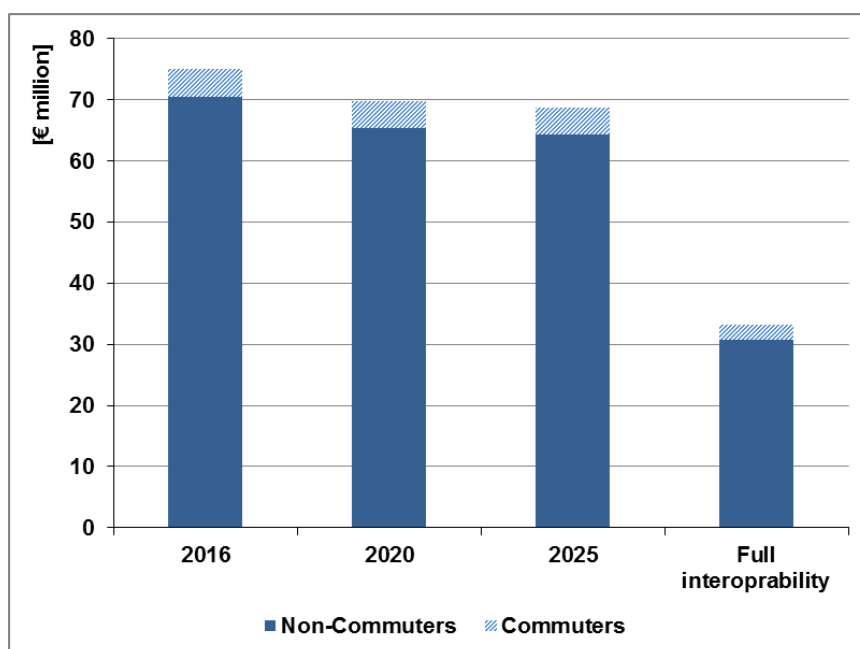
The model for cars assumed a penetration of OBUs amongst international travellers of 80% for commuters and 44% for non-commuters (See Section 1.2.2.4 for further explanation), as a smaller fraction of the latter are likely to use an interoperable OBUs for their infrequent journeys. Note that the penetration rates assumed refer only to cars travelling on international journeys.

Based on the assumed evolution of interoperability in the markets covered by ETC for passenger cars in the baseline, the total costs for passenger car users reduce by €6m (8%) from 2016 to 2020 and by a further €1m (2%) from 2020 to 2025. Regarding the category of users, the outputs obtained show that the large majority of total costs involve non-commuters (94%). Road users from EU Member States generate the majority of the costs, and benefit from the majority of the cost reductions through time.

With respect to the quantification of the costs of the lack of interoperability of electronic tolling for road users, this can be inferred by comparing the total costs at the three points in time, against the total costs assuming full interoperability. Thus, the total cost of the lack of interoperability for road users (including the assumed expansion plans for the coverage of EETS providers through time) in 2016, 2020 and 2025 are €41m, €37m and €36m, respectively.

In terms of implications, it is worth noting that the non-commuters category shows the higher cost reductions per vehicle, namely €1 over the period 2016-2025. However, they might be less inclined to change to an interoperable OBU because of their infrequent journeys. On the other hand, the commuters category shows the lowest cost reduction per vehicle, at €0.4 over the period 2016-2025, but they may be more inclined to accept the technology change because of the higher probability of use of an interoperable system<sup>16</sup>.

**Figure 2-6: Baseline annual costs to passenger cars for using road tolling infrastructure**



In addition to the costs of lack of interoperability for electronic tolling, simplified estimates have been developed for passenger cars for the time losses associated with international car road users due to lack of interoperability of EETS systems with national vignette and urban congestion charging schemes. These are discussed below.

The assessment of time losses for cars entering a country where a vignette is charged identified around 151,000 and 2.3 million vehicles potentially involved, for commuters and non-commuters respectively<sup>17</sup>. The value of time loss is calculated separately for the two categories of users<sup>18</sup>:

- Commuters are assumed more inclined to purchase an annual vignette for their more frequent journeys on international travel. The total estimated value of time loss is equal to €0.4m per

<sup>16</sup> International non-commuters could be high-income users (i.e., business) and more inclined to access this kind of facilities that facilitate their journeys.

<sup>17</sup> The estimated vehicles refer to those travelling on all international journeys that could be equipped with both vignette(s) and OBUs to complete their journey.

<sup>18</sup> The value of time of car users has been assumed according to the input of the TRUST transport model. This has been quantified as € 2.9/vehicle for commuters and € 8.3/vehicle for non-commuters. The values estimated differ as they depend on different values of load factor and values of time. With respect to time, it has been assumed that users lose 20 minutes to complete this process.

year for 2016. No estimate is provided for the future as it is assumed that there is no change in vignette systems in individual Member States in the baseline.

- Non-commuters are assumed more inclined to purchase weekly vignettes and less inclined to purchase monthly or annual vignettes for their infrequent international travel. According to the estimated distribution of the vignette purchased in the countries where this schemes are in place, the estimated time loss is equal to approximately €62m per year<sup>19</sup> in 2016. No estimate is provided for the future as it is assumed that there is no change in vignette systems in individual Member States in the baseline.

Regarding the urban areas where congestion charges are in place, another simplified analysis has been developed. Currently, congestion charges are levied to car road users accessing a limited number of urban areas in Europe: ten urban areas have been considered, of which seven already have a congestion charging scheme in place and three have undertaken feasibility studies suggesting that a congestion charge scheme would be beneficial to tackle road transport externalities (i.e. congestion, pollutant emissions and safety)<sup>20</sup>.

A simplified analysis was developed to estimate the number of cars<sup>21</sup> that could potentially benefit from integration of EETS systems with urban congestion charging schemes<sup>22</sup>, based on the number of international journeys expected to start or end in one of these ten congestion charging areas. Input data for this analysis was obtained from the TRUST transport model<sup>23</sup>.

Regarding the seven urban areas where congestion charge schemes are already in place, the results obtained show that the number of cars potentially involved is approximately 70,000 per year. Assuming the extension also to the three additional urban areas where congestion charging schemes are at feasibility stage, the number of cars potentially involved increases by a further 103,000<sup>24</sup>. The breakdown of the number of vehicles by congestion charging area is provided in Table 2-4 below.

With respect to the total number of cars involved in international travel (i.e. 6.45m, see Table 2-3), the share of vehicles which could potentially benefit from integration of congestion charge schemes with EETS is equal to 1.1% and 1.6% for the seven existing and three expected congestion charging schemes considered, respectively.

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<sup>19</sup> The estimated distribution of vignettes purchased - by period of validity (i.e., weekly, monthly and annual) - in the countries where these schemes are in place (i.e., Austria, Bulgaria, Czech Republic, Hungary, Romania, Slovakia and Slovenia) has been inferred based on a DG MOVE report on vignette systems (Booze & Co, 2010). The distribution obtained shows that the highest occurrence is for vignettes with the shortest period of validity, i.e., on a weekly basis (72%). The shares of monthly and annual vignette are 9% and 19% respectively. Regarding the actual number of weekly and monthly vignettes that non-commuters might purchase, this has been estimated based on the costs that could be borne purchasing weekly and monthly vignette in one year, with respect to the cost of an annual vignette (see also [www.tolls.eu](http://www.tolls.eu)). In this respect, it has been assumed that non-commuters may purchase on average 4 weekly vignette per year and 1.5 monthly vignettes per year.

<sup>20</sup> According to (Endurance Project, 2015) a number of European cities levy a congestion charge for driving a vehicle in an urban area: in the UK, London (2003) and Durham (2002); in Italy, the Milan 'Area C' (2012) evolved from the pollution tax scheme Ecopass (2008); in Malta, La Valletta; in Sweden, Stockholm congestion tax (2006) and Gothenburg (implemented in 2013, but continuation rejected in September 2014); in Norway, Oslo, Bergen and Trondheim. Several cities have looked into the option of congestion charging and studies suggest that a congestion charge would be beneficial, for instance for Graz and Vienna in Austria and for Helsinki in Finland. See also the Helsinki region congestion charge study (Finnish Ministry of Transport and Communications, 2011) and the VCO Factsheet (VCO Mobilitat Mit Zukunft, 2013) on Austria. For these cases, the timeline for implementation of the congestion charging systems is not available.

<sup>21</sup> The number of cars obtained is part of those estimated using interoperable road tolling systems.

<sup>22</sup> It is worth remarking that such integration could be potentially extended also to the collection of parking fees charged in urban areas. For example, in Milan the subscribers of TELEPASS can register the vehicle's number plate in order to pay both the congestion charge and parking fees. In this case the OBU is not needed, as the 'Area C' system recognises the plate of the registered vehicle when it passes through the gantry. We have not accounted for such integration in our analysis.

<sup>23</sup> In this exercise the number of cars have been estimated observing the flows from urban areas where congestion charges are applied to all destinations. The flows consider both commuters and non-commuters and assume spatial entities at NUTS3 level (i.e., Nomenclature des Unités Territoriales Statistiques). This is the smallest scale of the spatial units for socio-economic analysis of the regions and is deemed appropriate to fit this scale of analysis. See also EUROSTAT for the definition of NUTS levels.

<sup>24</sup> However, it is worth noticing that this share might be overestimated regarding the city of Helsinki. The share obtained is significantly high (i.e., 44%). This could depend on the fact that the NUTS3 spatial entity for Helsinki extends significantly beyond the borders of the metropolitan area.

**Table 2-4: Summary of congestion charging systems which could benefit from interoperability with EETS**

Level of implementation	Country	City	Share of cars potentially involved in country	Number of cars potentially involved
Operating	Italy	Milano	9%	35,066
	Norway	Oslo, Bergen and Trondheim	23%	7,643
	Sweden	Stockholm & Göteborg	13%	17,035
	UK	London	13%	10,169
	<b>Total</b>			
Feasibility study	Austria	Vienna and Graz	20%	70,726
	Finland	Helsinki	44%	32,342
	<b>Total</b>			

The assessment of the time losses for cars entering an urban area where a congestion charge scheme is in place has been obtained by multiplying the number of cars potentially involved by the estimated monetary value of the time loss for lack of interoperability between the systems<sup>25</sup>.

Regarding the cars travelling to urban areas where congestion charges are already in place the estimated value of the time loss is equal to €1.2m per year. Extending this exercise also to the urban areas where a congestion charge scheme has been considered for future implementation, the value of the estimated time loss is equal to an additional €1.8m per year, i.e. a total cost to road users of approximately €3.0m.

## 2.3 Subtask 1.3: Quantify in monetary terms the costs of lack of interoperability of electronic tolls for toll chargers

Activities under Task 1.3 were focused on developing a general purpose economic model that provides – on the basis of a set of configurable parameters – an estimate of the costs of implementing and putting into operation a generic electronic toll collection system, based on different technological options (DSRC, GNSS and ANPR in particular).

The model allows an estimation of implementation and operating costs based on the following configurable parameters:

- Tolling technology
- Enforcement technology
- Network length and topology
- Amount of tolling and/or enforcement equipment
- Number of road users
- Level of traffic
- Ratio of users equipped with OBU (e.g. 100% for schemes with mandatory OBU)
- Ratio of users equipped by EETS providers
- Split of users between local and international

<sup>25</sup> The time loss for autonomously managing both the registration procedure and the payments has been estimated equal to €17/vehicle. With respect to the time, it has been assumed that the user loses 30 minutes to complete this process. These inputs rely on the TRUST transport model on long distance international travel.

- Number of service points

These configurable parameters and the various cost elements required have been populated based on our experience with the implementation and operation of different electronic toll collection schemes in Europe (e.g. cost of an OBU).

The idea is to use such a model to represent (by applying the relevant parameters) the four different case studies as identified in Section 1.2.3 above and the study inception report:

- A nationwide DSRC-based free-flow electronic toll collection scheme for heavy goods vehicles (based on the scheme that will be put in operation in Slovenia in 2018)
- A nationwide GNSS-based free-flow electronic toll collection scheme for heavy goods vehicles (based on the scheme that was put in operation in Belgium during 2016)
- A local DSRC-based electronic tolling system (together with other more traditional payment means) for all vehicles (based on the Liefkenstoek Tunnel in Belgium);
- A local DSRC- and ANPR-based free-flow electronic tolling system for all vehicles that includes all the different types of schemes currently deployed in Europe (based on the Dartford Crossing in UK).

The above-mentioned case studies differ in terms of:

- Technology (DSRC, GNSS and ANPR);
- Network length and topology (nationwide vs local infrastructure)
- Charging model (mandatory OBU vs optional use of the OBU).

In all the different cases, the use of the model (with different sets of parameters) provides the possibility of estimating the overall implementation and operating costs in a base case scenario (corresponding to the scenario in which the scheme is implemented without leveraging EETS providers and without using synergies with other toll domains) and in other scenarios where the above-mentioned conditions are taken into account.

### 2.3.1 Case Study # 1: a nationwide DSRC-based free-flow electronic toll collection scheme for heavy goods vehicles

For the evaluation of this specific case study, we have used the characteristics and the size of the nationwide DSRC-based free-flow toll collection system for heavy goods vehicles that is currently being implemented in Slovenia.

This particular system is characterised by the following solutions and parameters:

- Tolling Technology: DSRC free-flow with mandatory OBU for all vehicles; the whole road network is divided into elementary sections, a free-flow tolling station is installed on each elementary section (tolling stations detect and register vehicles properly equipped with OBUs)
- Enforcement Technology: DSRC & ANPR based stationary, portable and mobile equipment ensuring effective control of the vehicles in transit (enforcement stations verify whether eligible vehicles are equipped and register evidence in case of non-compliance)
- Road Network: 560 km
- Toll Sections: 126 (bi-directional)
- Tolling Equipment: 237 units
- Enforcement Stationary Equipment: 15 units
- Limited number of service points: 16
- Users: 150,000 total users

Taking these parameters into account and using the economic model we developed, the overall implementation cost in the Base Scenario is equivalent to that described in Table 2-5.

**Table 2-5: Summary of costs to establish a nationwide DSRC-based free-flow electronic toll collection scheme for heavy goods vehicles**

Cost Element	Qty.	Unit Cost (EUR)	Total Cost (EUR)	Note
OBU (Local)	150,000	10	1,500,000	OBUs procured and distributed by local system operator
Tolling Stations	237	150,000	35,550,000	Tolling-only roadside equipment, including civil works
Enforcement Stations	15	350,000	5,250,000	
Central System	1	40,000,000	40,000,000	Data centre with software apps.
Distribution Network	16	35,000	560,000	Set-up of automatic OBU distribution points
System Integration	1	20,000,000	20,000,000	End to end system integration
IT Infrastructure	1	2,000,000	2,000,000	Set-up of data network
Pre-Operation	1	1,500,000	1,500,000	Pre-operation activities
Start-Up	1	3,000,000	3,000,000	Set-up of operating company
<b>TOTAL</b>			<b>109,360,000</b>	

In this type of scheme, implementation costs (as outlined by the above table) are mainly related to the deployment of roadside equipment along the whole road network (tolling and enforcement equipment), including civil works, and the set-up of a central data processing system for data processing and storage. The overall yearly operating costs in the Base Scenario are described in Table 2-6.

**Table 2-6: Summary of costs (on a yearly basis) to operate a nationwide DSRC-based free-flow electronic toll collection scheme for heavy goods vehicles**

Cost Element	Yearly Cost (EUR)	Note
Maintenance Roadside Equipment (Tolling & Enforcement)	973,500	10% of the ownership value of electronic components
Maintenance Central System	6,000,000	15% of the ownership value of the central system

Cost Element	Yearly Cost (EUR)	Note
Maintenance Distribution Network	72,000	15% of the ownership value of electronic components
Telecommunication	965,280	SDSL lines to connect all peripheral devices with central system
Call Centre	216,000	200 daily contacts per 100.000 users, 2 EUR per call
OBU Distribution	38,400	200 EUR monthly fixed costs per site
Payment Management	200,000	2% commission fee paid to payment means issuer
Billing & Invoicing	337,500	A monthly invoice sent to all clients (average 8 vehicles)
Logistics	5,760	Logistics to Distribution Points
OBU Maintenance	561,000	22% of distributed OBU to be refurbished
Automatic Enforcement	222,222	20 EUR handling costs per potential violation
Mobile Enforcement	888,888	130 EUR handling costs per violation
<b>TOTAL</b>	<b>10,480,000</b>	

These costs represent the key operation costs elements in an average year; the first year of operation – depending on the start-up strategy (e.g mandatory OBU, handling of occasional users, etc.) – may have an impact (increase) on the operation costs for the first year of operation that has not been estimated in this case.

In this case operation costs are mainly related to maintenance of peripheral and central components (roadside equipment for tolling and enforcement, distribution points and central system respectively), telecommunication, customer care management (in particular call centre), commissions of performed payment, billing and invoicing, OBU maintenance and enforcement (automatic and mobile/manual).

By using the same model, it is then possible to estimate how the implementation cost may change in two specific scenarios:

- Scenario A: a part of the OBUs are procured and distributed by EETS Providers
- Scenario B: synergies are identified with neighbouring toll chargers in order to optimise overall costs
- For Scenario A, we assumed that 40% of concerned road users will be equipped via EETS providers that are active in the area. Under these conditions, the overall implementation costs is only slightly reduced, with operating costs remaining basically unchanged. The small reduction is due to the fact that the overall number of OBUs is in this case limited and that the procurement cost of a DSRC unit is low (in the range of €10). The rest of the system cannot be

optimised. A **reduction of less than 1% of total costs has been estimated; no significant change in operating costs.**

- For Scenario B, we assumed that the relevant toll charger agrees with a neighbouring toll charger to make use of a central system that has already been deployed, taking into account that all systems are usually dimensioned in a way that a significant amount of additional toll transactions can be managed without changes. As the implementation costs for the central system are significant, in this case a **reduction of more than 35% of total implementation costs and of more than 65% of total operating costs has been estimated.**

### 2.3.2 Case Study # 2: a nationwide GNSS-based free-flow electronic toll collection scheme for heavy goods vehicles

For the evaluation of this case study, we have used the characteristics and the size of the nationwide GNSS-based free-flow toll collection system for heavy goods vehicles that entered into operation in April 2016 in Belgium.

This particular system is characterised by the following parameters:

- Tolling technology: GNSS free-flow with mandatory OBU for all vehicles (the OBU registers its positions along the road network and the tolling equipment provides the identification of elementary sections into which the road network is divided, recognising the travelled route and measuring the travelled distance)
- Enforcement technology: DSRC and ANPR based stationary, portable and mobile equipment ensuring a statistical control upon the vehicles in transit (enforcement stations verify whether eligible vehicles are equipped and register evidence in case of non-compliance)
- Road network: a network of 6,866 km is charged, out of a total road network of more than 154,000 km (charged with a zero tariff)
- Toll sections: the whole charged road network is formally not divided into elementary sections, the business rules foresee the measurement of the travelled distance rather than the detection of the travelled sections
- Tolling equipment: no roadside tolling equipment necessary (not even augmentation beacons)
- Stationary enforcement equipment: 42 units
- A significant number of Service Points: 150
- Users: 700,000, of which 550,000 foreign users (55% of the foreign users were expected to be regular)

Taking these parameters into account and using the economic model we developed, the overall implementation cost in the Base Scenario is equivalent to that described in Table 2-7.

**Table 2-7: Summary of costs to establish a nationwide GNSS-based free-flow electronic toll collection scheme for heavy goods vehicles**

Cost Element	Q.ty	Unit Cost (EUR)	Total Cost (EUR)	Note
OBU (Local)	700,000	156	109,200,000	OBUs procured and distributed by local system operator
Tolling Stations	0	150,000	0	Tolling-only roadside equipment, including civil works
Enforcement Stations	42	350,000	14,700,000	
Central System	1	40,000,000	40,000,000	Data centre with SW applications



Distribution Network	150	35,000	5,250,000	Set-up of automatic OBU distribution points
System Integration	1	20,000,000	20,000,000	End to end system integration
IT Infrastructure	1	2,000,000	2,000,000	Set-up of data network
Pre-Operation	1	1,500,000	1,500,000	Pre-operation activities
Start-Up	1	3,000,000	3,000,000	Set-up of operating company
<b>TOTAL</b>			<b>195,650,000</b>	

In this type of scheme, implementation costs (as outlined by the above table) are mainly related to the procurement of OBUs (a GNSS-based OBU has a significant cost on the market), the deployment of roadside equipment along the whole road network (enforcement equipment only), including civil works, the deployment of an extensive distribution network and the set-up of a central data processing system for data processing and storage. The overall yearly operating costs in the Base Scenario are described in Table 2-8.

**Table 2-8: Summary of costs (on a yearly basis) to operate a nationwide GNSS-based free-flow electronic toll collection scheme for heavy goods vehicles**

Cost Element	Yearly Cost (EUR)	Note
Maintenance Roadside Equipment (Tolling & Enforcement)	735,000	10% of the ownership value of electronic components
Maintenance Central System	6,000,000	15% of the ownership value of the central system
Maintenance Distribution Network	675,000	15% of the ownership value of electronic components
Telecommunication (Fix)	743,760	SDSL lines to connect all peripheral devices with central system
Telecommunication (Mobile)	8,400,000	1 EUR flat per month per OBU
Call Centre	1,008,000	200 daily contacts per 100.000 users, 2 EUR per call
OBU Distribution	360,000	200 EUR monthly fixed costs per site

Cost Element	Yearly Cost (EUR)	Note
Payment Management	1,400,000	2% commission fee paid to payment means issuer
Billing & Invoicing	1,575,000	A monthly invoice sent to all clients (average 8 vehicles)
Logistics	54,000	Logistics to Distribution Points
OBU Maintenance	728,000	2% of distributed OBU to be refurbished
Automatic Enforcement	2,592,592	20 EUR handling costs per potential violation
Mobile Enforcement	4,355,555	130 EUR handling costs per violation
<b>TOTAL</b>	<b>28,627,000</b>	

These costs represent the key operating cost elements in an average year; the first year of operation – depending on the start-up strategy (e.g. mandatory OBU, handling of occasional users) – may have an impact (increase) on the operating costs for the first year of operation that has not been estimated in this case.

In this case operating costs are mainly related to maintenance of peripheral and central components (roadside equipment for enforcement, distribution points and central system respectively), telecommunication (fixed and mobile), customer care management (in particular call centre), commissions paid for payments made, billing/invoicing and enforcement (automatic and mobile/manual).

By using the same model, it is then possible to estimate how the implementation cost may change in two specific scenarios:

- Scenario A: a part of the OBUs are procured and distributed by EETS Providers
- Scenario B: synergies are identified with neighbouring toll chargers in order to optimise overall costs

For Scenario A, we assumed that 40% of concerned road users will be equipped via EETS providers that are active in the area. Under these conditions, the overall implementation costs is significantly reduced, thanks to the procurement cost for a GNSS OBU (in the range of €150 plus the SIM card for GSM/GPRS communication). The rest of the system cannot be optimised. **A reduction of more than 20% of total implementation costs as well as of about 15% of yearly operating costs is estimated.**

For Scenario B, we assumed that the relevant toll charger agrees with a neighbouring toll charger to make use of a central system that has already been deployed, taking into account that all systems are usually dimensioned in a way that a significant amount of additional toll transactions can be managed without changes. As the implementation costs for the central system is significant, in this case **a reduction of more than 40% of total implementation costs and of about 20% of yearly operating costs has been estimated.**

### 2.3.3 Case Study # 3: a local DSRC-based electronic tolling system (together with other more traditional payment means) for all vehicles

For the evaluation of this case study, we have used the characteristics and the size of a local plaza-based toll collection system for all vehicles, supporting the collection of tolls for the use of the Liefkenstoek tunnel in Belgium.

This particular system is characterised by the following solutions and parameters:

- The toll plaza includes 18 different toll lanes (9 per direction);
- Road users can pay with different payment means, including cash, payment cards and DSRC-based ETC;
- Electronic toll collection is therefore not the only means of payment, in fact the share of ETC transactions is limited, potentially growing in the future thanks to interoperability with the neighbouring GNSS-based system operated by Satellic NV on behalf of VIAPASS and the three regions;
- The tolling facility is characterised by about 8 million transactions per year, performed by an average of 150,000 vehicles.

Taking these parameters into account and using the economic model we developed, the overall implementation cost in the Base Scenario is equivalent to that described in Table 2-9.

**Table 2-9: Summary of costs to establish a local DSRC-based single lane electronic toll collection scheme for all vehicles**

Cost Element	Q.ty	Unit Cost (EUR)	Total Cost (EUR)	Note
OBU (Local)	90,000	10	900,000	OBUs procured and distributed by local system operator
Tolling Stations	10	20,000	250,000	Tolling equipment integrated within the lanes to handle ETC transactions
Central System	1	5,000,000	5,000,000	Data centre with SW applications
Distribution Network	2	35,000	70,000	Set-up of automatic OBU distribution points
System Integration	1	2,500,000	2,500,000	End to end system integration
IT Infrastructure	1	150,000	150,000	Set-up of data network
Pre-Operation	1	250,000	250,000	Pre-operation activities
<b>TOTAL</b>			<b>9,120,000</b>	

This estimation takes into account only marginal costs related to the introduction of ETC services onto an existing traditional toll collection facility.

In this type of scheme, implementation costs (as outlined by the above table) are mainly related to the procurement of OBUs (not a significant cost), the implementation of ETC-related equipment within the toll lanes in the toll plaza, the upgrading of the central system with ETC-related functionalities and customer care management, and finally the end to end system integration. The overall yearly operating costs in the Base Scenario are described in Table 2-10.

**Table 2-10: Summary of costs (on a yearly basis) to operate a local DSRC-based single lane electronic toll collection scheme for all vehicles**

Cost Element	Yearly Cost (EUR)	Note
Maintenance Tolling Equipment	2,500,000	10% of the ownership value of electronic components
Maintenance Central System	750,000	15% of the ownership value of the central system
OBU Distribution	50,000	1 FTE
Payment Management	24,900	2% commission fee paid to payment means issuer
Billing & Invoicing	270,000	A monthly invoice sent to all clients (average 8 vehicles)
Logistics	108,000	Logistics to Distribution Points
OBU Maintenance	30,600	2% of distributed OBU to be refurbished
<b>TOTAL</b>	<b>3,625,500</b>	

In this case, operating costs are mainly related to maintenance of peripheral and central components (ETC related equipment within the toll lanes and central system respectively). Additionally, the system operator faces other costs for the operation and maintenance of the toll plaza and related business processes that are not considered here as they are not related to electronic toll collection.

By using the same model, it is then possible to estimate how the implementation costs may change in two specific scenarios:

- Scenario A: a part of the OBUs are procured and distributed by EETS Providers
- Scenario B: synergies are identified with neighbouring toll chargers in order to optimise overall costs

For Scenario A, we assumed that 40% of road users will be equipped via EETS providers that are active in the area. Under these conditions, the overall implementation costs do not change significantly, as the system operator sees no benefit in terms of OBU procurement. As the use of OBUs is not mandatory in this case, the acceptance of OBUs issued by other players has an impact only on the operating costs. The size of the system, though, is such that this impact is in any case very limited. **Overall the impact on implementation and operating costs related to interoperability is very limited.**

For Scenario B, we assumed that the relevant toll charger agrees with a neighbouring toll charger to make use of a central system that has already been deployed, taking into account that all systems are usually dimensioned in a way that a significant amount of additional toll transactions can be managed without changes. As the implementation costs for the central system is significant, in this case a **reduction of about 35% of total implementation and of about 20% of the yearly operating costs has been estimated.**

### 2.3.4 Case Study # 4: a local DSRC- and ANPR-based free-flow electronic toll collection scheme for all vehicles

For the evaluation of this specific case study, we have used the characteristics and the size of the local DSRC- and ANPR-based free-flow toll collection system for all vehicles that is in operation since 2014 for the Dartford Crossing in UK.

This particular system is characterised by the following parameters:

- Charging is implemented by means of a free-flow tolling and enforcement station intercepting all vehicles crossing the facility;
- All vehicles are identified in this case by means of their license plate number (by using ANPR mechanisms); road users are provided with the possibility of paying upfront or within 24 hours from using the system (by means of different Internet-based mechanisms as well as through local outlets);
- Traffic totals about 50 million transactions per year, with an average of 130,000 vehicles per day;
- In the case of a vehicle not paying within the time limit, an enforcement procedure is put in place;

Taking these parameters into account and using the economic model we developed, the overall implementation cost in the Base Scenario is equivalent to that described in Table 2-11.

**Table 2-11: Summary of costs to establish a local ANPR-based free-flow electronic toll collection scheme for all vehicles**

Cost Element	Qty.	Unit Cost (EUR)	Total Cost (EUR)	Note
Roadside (Tolling & Enforcement) Station	1	1,000,000	1,000,000	Tolling & Enforcement roadside equipment, including civil works
Central System	1	15,000,000	15,000,000	Data centre with software apps.
Distribution Network	20	35,000	700,000	Set-up of automatic OBU distribution points
System Integration	1	10,000,000	10,000,000	End to end system integration
IT Infrastructure	1	2,000,000	2,000,000	Set-up of data network
Pre-Operation	1	1,500,000	1,500,000	Pre-operation activities
Start-Up	1	3,000,000	3,000,000	Set-up of operating company
<b>TOTAL</b>			<b>33,200,000</b>	

In this type of scheme (with limited roadside equipment), implementation costs (as outlined by the above table) are mainly related to the set-up of a central data processing system for data processing and storage, as well as to the end-to-end system integration.

The overall yearly operating costs in the Base Scenario are described in Table 2-12.

**Table 2-12: Summary of costs (on a yearly basis) to operate a local ANPR-based free-flow electronic toll collection scheme for all vehicles**

Cost Element	Yearly Cost (EUR)	Note
Maintenance Roadside Equipment (Tolling & Enforcement)	112,500	10% of the ownership value of electronic components
Maintenance Central System	2,250,000	15% of the ownership value of the central system
Maintenance Distribution Network	5,250	15% of the ownership value of electronic components
Call Centre	156,000	200 daily contacts per 100.000 users, 2 EUR per call
OBU Distribution	100,000	200 EUR monthly fixed costs per site
Video Tolling Processing	5,000,000	5% tolling transactions requiring human validation + payment commissions
Violation Processing	2,500,000	5 EUR handling costs per potential violation
General Administration	480,000	
<b>TOTAL</b>	<b>10,603,750</b>	

In this case operation costs are mainly related to maintenance of peripheral and central components (roadside equipment for tolling and enforcement, distribution points and central system respectively), customer care management (in particular call centre), management of ANPR-based video tolling transactions, commission related to payments made and handling of violations.

By using the same model, it is then possible to estimate how the implementation cost may change in two specific scenarios:

- Scenario A: a part of the OBUs are procured and distributed by EETS Providers
- Scenario B: synergies are identified with neighbouring toll chargers in order to optimise overall costs

The Scenario A, to be realistic, should be associated to an opening of the value chain to EETS providers and to the possibility of users paying by means of DSRC OBUs (which is currently not the case). Depending on the character of the traffic (local and regular vs occasional users), the use of DSRC OBUs may or may not be an advantage. As demonstrated by urban congestion charging schemes such as the one in Stockholm, handling of local users is perfectly possible by means of ANPR and related mechanisms; in these specific cases, the use of OBUs is not an advantage. Where traffic is characterised by a significant portion of occasional vehicles, in particular heavy goods vehicles, the management of DSRC OBUs may have a significant impact on the operating costs, as it would contribute to reduce the cost necessary to process video toll transactions. **Overall, no major impact can be anticipated in terms of implementation costs, whereas operating costs can be reduced by about 5 to 10%.**

For Scenario B, we assumed that the relevant toll charger agrees with a neighbouring toll charger to make use of a central system that has already been deployed, taking into account that all systems are usually dimensioned in a way that a significant amount of additional toll transactions can be managed

without changes. As the implementation costs for the central system are significant, in this case a **reduction of about 40% of total implementation costs and of about 20% of total operating costs has been estimated.**

### 2.3.5 Summary of findings

Results from the first two case studies indicate that there are clear benefits available to toll chargers from achieving interoperability with other toll domains. However, the magnitude of these savings varies considerably depending on the design of the tolling system, with GNSS-based systems making significant savings from sharing OBU deployment with EETS providers and both DSRC- and GNSS-based systems making significant savings from using a central back-office system shared across multiple toll chargers.

For what concerns the other two case studies, representative of charging schemes where the use of an OBU is not mandatory (and in one case not even used), benefits to toll chargers from achieving interoperability with other toll domains are not as clear and strongly depend on the penetration of electronic charging mechanisms within the road user traffic.

Setting up interoperability agreements with EETS providers having already distributed OBUs to their clients can have a positive effect of increasing the number of users of ETC payment methods, thereby reducing in principle operating costs shifting traffic from traditional to innovative and less expensive payment methods (for example OBU-based transaction costs are lower than manual toll collection costs). With technological development (in particular in relation to ANPR-based mechanisms) these benefits can be less evident in the case of electronic toll schemes with a majority of local users.

### 2.3.6 Simulation of an EU-wide application of the findings

Using the cost models developed for the different type of electronic toll collection systems deployed across the EU, we have carried out an estimation of the total yearly cost associated with the operation of all electronic toll collection systems for heavy goods vehicles in the EU. Please see Table 1-11 in Annex A for a detailed breakdown of the outputs from this analysis.

When interpreting the outputs of this analysis, it must be noted that the electronic toll collection market is today characterised by a variety of schemes, which differ in terms of:

- Technology (in particular between DSRC, GNSS and/or ANPR technologies);
- Size (nationwide vs. regional or local schemes);
- Implementation environment (toll plaza-based vs. free-flow multilane);
- Operating model:
  - Mandatory vs. discretionary use of OBUs;
  - Vehicles covered by scheme: certain countries/toll chargers have deployed an electronic charging scheme only for HDVs, whereas other countries/toll chargers apply the same system to charge both light and heavy duty vehicles;
  - Use of shared infrastructure: in many cases (and this is the case for large countries such as France, Italy and Spain) electronic tolling schemes have been deployed based on existing, shared infrastructure.

The estimation of cumulative operating costs is strongly influenced by these differences between schemes.

For the sake of this analysis, we have in particular considered:

- The whole operating costs for the cases where the tolling schemes have been specifically deployed to charge HDVs by electronic means only;
- Only marginal operating costs for the cases where electronic toll collection is only one of the possible means.

Based on these assumptions, we have estimated that all the electronic toll collection systems across the EU today require a total operating cost of about €700m per year.<sup>26</sup>

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<sup>26</sup> The calculation leading to this total doesn't include an estimation for Norway. However as the assumptions we used for this exercise systematically integrate a healthy margin, and as Norway's cost are relatively low in the EU context (only a central system), the total aggregated

Through applying a similar method as that applied in the case studies above, we have also estimated the reduction in operating costs that could be achieved through promoting greater interoperability between systems across the EU. The reduction in operating costs through promoting EETS interoperability across the EU has been estimated using this method to be only marginal at c. 5% (by assuming a reasonable market penetration by EETS providers, in the range of 40% of users), or c. €30m per year. A further reduction in operating costs can be expected with an even higher market penetration for EETS providers (100% of users registered with an EETS provider), up to 18% of the yearly operating costs in the nominal case.

The main reason for such a small improvement is that, although EETS is not yet a reality across the EU, the largest markets in the EU are already mature and saturated in terms of OBUs and electronic toll collection clients. As such, the introduction of an EU-wide EETS service would result in only a marginal increase in users rather than a significant transfer of users from local/national to transnational service providers, with only a limited knock-on impact on the overall business case.

A more significant improvement in total operating costs could be achieved by promoting the sharing of system infrastructure between different toll chargers (in particular the sharing of the central data processing infrastructure). In this case, it is estimated that a potential reduction of about 15% of operating costs could be achieved, or c. €100m per year.

## 2.4 Subtask 1.4: Quantify in monetary terms the costs of toll evasion for toll chargers due to the lack of co-operation between Member States on cross-border enforcement

Toll evasion is seen as a major issue by toll chargers and Member States. In many cases, the main problem they see is not the actual loss of earnings (which is real but seen as marginal for many) but the distortion of competition at the expense of domestic companies, stemming from the unequal treatment of foreign hauliers.

Today, most countries simply don't chase foreign toll evaders, either because their numbers are small or the cost of the necessary (and potentially unsuccessful) measures required to recover the unpaid tolls are too high in comparison, or because they simply don't have any reliable options for cross-border toll recovery.

According to Spanish operator Abertis<sup>27</sup>, the cost of prosecutions for toll infringements represents around 5% of free flow administrative costs (Abertis, 2016).

### 2.4.1 Quantitative analysis of toll evasion rates

In most free-flow toll domains, the toll evasion rate is much higher within the non-resident driver group, compared to vehicles registered within the same Member State:

- In **France**, non-residents (HDV and LDV) account for 40% of the total number of offenders. This share can go up to 95%, for HDVs only, in very sensitive toll domains (most exposed to cross-border traffic). With foreign-registered HDVs representing less than 10% of total traffic in France, these figures illustrate how much worse the toll evasion problem is for foreign-registered vehicles (Eurostat, 2013-2014).
- In **Austria**, the same distortion is observed as, according to ASFINAG, 89% of tolling violations in 2015 stemmed from non-Austrian residents (108,000 out of 122,000 cases), when the share of foreign trucks is below 40%. ASFINAG's enforcement revenues (fines paid) in 2015 amounted to €30.8m.
- In the same year, at the Dartford Crossing (**United Kingdom**) the share of toll violation due to non-residents amounted to 26%, out of a total average toll evasion rate of 2.5% (Abertis, 2016).

In the toll domains with a low violation rate (due to high penalties, large mobile enforcement fleet or physical toll plazas), the difference is marginal:

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estimation of costs we have obtained (counting only costs of the EU countries) gives an accurate view of the costs for the size of the market considered, even without including figures from Norway.

<sup>27</sup> Abertis, Position Paper on Toll Enforcement, July 2016



- In **Belgium**, 25% of toll evasions stem from Belgian trucks, which is in accordance with the distribution of the registered trucks (75% foreign / 25% domestic). The rules are particularly stringent in the newly launched GNSS-based system in Belgium and six months after the Viapass system was put into operation, the rate of toll evasion is below 1%. There is no limit regarding the number of fines that can be applied, whilst the very large size of the fine (€1,000) is a strong deterrent and Viapass considers that by the third time a toll evader comes to Belgium, they have a strong chance of being caught by mobile enforcement units. Given the low toll evasion rates and high interception rate, Viapass notes that fraud has no significant impact on revenues in the three Belgian regions. Nevertheless, Viapass considers it unfair that a truck from a Belgian company which has been detected as a toll evader will systematically receive its fine, whilst foreign-registered vehicles will be caught only if they pass through Belgium again, thereby supporting the case for more European cooperation.
- In **Sweden**, where the two toll domains are gated bridges, the toll evasion rate is also very low. This observed rate is the same for domestic and transnational traffic.
- In **Spain**, toll fraud is currently not a significant issue, as the tolling scheme is based on barriers which limit the opportunity for fraud. The small number of Spanish toll evaders are automatically tracked but nothing is done for foreign-registered vehicles. However, the removal of the tolling barriers is being considered as a near-term future development, so toll evasion is nevertheless seen as an important issue by SEOPAN and it wants the Commission to build a legal framework for international toll evasion recovery in Europe.
- In **Slovenia**, the existing system is based on toll gates, which limit toll evasion cases. According to DARS, the evasion rate is less than 1%, supported additionally by its road patrol (20 units), enforcement team of more than 100 staff and a large fine currently stranding at €1,500 per violation.

However as more systems gradually move towards free-flow tolling systems, there is strong support for a coordinated measure supported by the EC to aid recovery of unpaid tolls across borders, both from Member States where evasion rates are higher and from those where evasion rates are currently low. Currently the lack of efficient cross-border enforcement forces those systems wishing to chase foreign offenders to invest significantly in enforcement and/or impose extremely high fines, thereby increasing the overall costs of the systems, but also reducing the level of acceptability of the system to road users.

## 2.4.2 Bilateral agreements

According to the stakeholders<sup>28</sup> we have interviewed as part of Task 2.6, very few bilateral agreements exist between Member States for exchange of vehicle registration data concerning toll evasion. Indeed, toll fraud is not in the scope of the eight types of fraud addressed in the Cross Border Enforcement Directive (2011/82/EU), i.e. fraud which is seen as endangering the safety of road users. Whilst licence plate databases of some Member States are open (at a fee), no process for cooperation on toll evasion is foreseen, which is considered by toll chargers as a prerequisite for any efficient cross-border enforcement solution.

### 2.4.2.1 The German-Austrian case

The only bilateral agreement we are aware of is the one between Austria and Germany. The agreement covers both the exchange of vehicle registration data between the two countries but also the application of administrative penalties, which allow the Austrian authorities to have a relay in Germany to prosecute proven toll evaders in their territory. This second aspect has proven to be the most valuable part of the agreement and is one of the major reasons for the high rate of toll recovery achieved by ASFINAG towards German offenders.

Thus, German drivers who evade a toll on the Austrian side of the border, can be sent a 'substitute toll' notification asking them to pay an increased toll (as drivers from other countries who are registered in ASFINAG do) but can also be prosecuted in their own country.

In practice, when a German user is identified as a toll evader and leaves the Austrian territory, their vehicle registration details are stored for three months in a black list database, so that if they come back to Austria in this timeframe they are systematically stopped by the control agency (SKD – "Service und Kontrolldienst"). After three months, a request for vehicle registration data to the German authorities

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<sup>28</sup> ASECAP, ASFA in France, SEOPAN in Spain, Viapass in Belgium, DARS in Slovenia, the FTA, the UETR

is triggered and the 'substitute toll' is sent. If the substitute toll is not paid in the required time, a notification to administrative authorities is triggered. This unique cooperation between Germany and Austria enables high recovery rates (although some issues do exist, for example a significant number of non-German vehicles are registered in Germany under a German licence plate, so when triggering the bilateral procedure the attempt to identify the driver fails).

In comparison, for non-German countries, the chances of ASFINAG identifying offenders are lower (this is only possible if the user is registered with ASFINAG, for example to enable post-payment of tolls). Even if identified, there are no effective means available to ASFINAG to ensure/enforce that identified offenders pay the substitute toll, unless they return to Austrian territory and are intercepted by an enforcement patrol.

The success of the bilateral agreement between Austria and Germany is supported by data on toll recovery rates:

- For German-registered vehicles, only 11% of unpaid tolls were not recovered in 2015;
- For non-German EU Member States, the share of unrecovered tolls goes up to 21%;
- For non EU countries, this share is at 23%.

As for the recovery rate of tolls via the initial 'substitute toll' procedure, the recovery rates for Germany are also twice as high as for other countries (28% of substitute tolls are paid in Germany vs. only 13% for non-German EU countries and 10% for non-EU countries). The data shows a clear benefit for toll recovery rates when cross-border cooperation on administrative procedures is in place.

#### 2.4.2.2 Applicability to other markets

The kind of cross-border administrative procedure in place between Austria and Germany is seen by most countries<sup>29</sup> as the key measure to be implemented at the EU level to tackle toll evasion within the common market.

The example of France provides further insight as to how such a system might work in practice, as the toll recovery measures put in place in 2012 in the frame of the "Grenelle II" law have proved to be very efficient, leading to a significant drop in evasion rates from French drivers (reduced by a factor of 2.4). The principle, similar to that in place in Austria, is as follows:

- When a non-payment is identified, the driver automatically receives a 'transaction proposal' (i.e. not a penalty notification) to rectify the situation, equivalent to the price of the due toll + €20 contribution towards administrative costs;
- If this transaction is not completed at this stage, the case proceeds towards French penal law.

The 'threat effect' seems very powerful in the way it discourages toll evasion, as potential violators know they will be systematically identified and tracked (and eventually taken to court). The lack of such consequences for toll evaders in the existing European ETC cooperation framework is one of the main issues that needs resolving according to most Member States.

Clearly the limitation of the French approach resides in the fact that only French HDV drivers are impacted, not foreign-registered drivers. It is very difficult to identify the registration details foreign vehicles but even if they are identified, then no relay exists towards penal law in the country of origin of the toll evader. Broader cross-border application of the Austrian-German approach could help to resolve this issue.

#### 2.4.3 Toll recovery agencies

Our attempts to contact private toll recovery agencies have unfortunately been unsuccessful, as they have not been willing to disclose any information on their operations despite repeated requests.

The position of toll chargers we interviewed is that such companies provide a service that is not compatible with the public accountability and ethical code of conduct expected from a public authority, for two main reasons:

- The low level of transparency on their access to sources of information and personal data
- The controversial methods they sometimes use to recover debts.

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<sup>29</sup> According to the responses to the 2016 targeted consultation as part of Task 2.2

Whilst a number of toll chargers use such service providers (e.g. toll chargers in Spain, Norway, Ireland and Hungary), most toll chargers (and all other consulted stakeholders) strongly advocate the implementation of an EU-wide cooperation on enforcement based on registration data exchange and transnational prosecution, so as to be in position to avoid relying on such companies.

#### 2.4.4 Implications for EU-level action

Based on the above, it can be seen that a combination of the German-Austrian cooperation framework and the Austrian / French toll-recovery approach could lead to significant improvements in both internal and cross-border toll recovery rates. More generally, action required by the EC to enable such systems to be established should include:

- Enabling the cross-border sharing of a database of national vehicle registration details;
- Ensuring that toll evasion in one European Member State has a direct link to local penal law (after an initial conciliation procedure) in any Member State, regardless of where the offence is committed or where the vehicle is registered.

## 2.5 Subtask 1.5: Analyse main legal and contractual obstacles to the access of EETS providers/independent toll service providers to the toll collection market

EETS providers are required to enter the toll collection market on an EU-wide basis by Article 4.1 of Commission Decision 2009/750/EC. The obstacles to aspiring EETS providers achieving this stem in the main from the dominant position of national or regional toll service providers. Whilst other factors such as variations in national accreditation processes, and the time and expense that they involve, are widely complained of, our research suggests that legal obstacles to EETS may have less to do with national legislation or contractual provisions as such than with the lack of a level playing field in many Member States. Where such a situation can be shown to exist – and it has been frequently alleged by EETS providers - it risks offending the obligation placed on toll chargers in Article 5.3 of the Commission Decision to accept EETS providers on a non-discriminatory basis.

To set this in context it is necessary to examine the way national legislation and regulations generally implement EETS and then to consider the tendering out of electronic toll collection to the potential providers and the terms offered by toll chargers. Finally, if unfairness and discrimination are alleged, the question arises whether national Conciliation Bodies are best placed to resolve such disputes.

The interview programme carried out as part of Task 2.6, contributed significantly to the findings outlined in Task 1.5. As well as relying on the views expressed to us by stakeholders, our analysis is supplemented with the material available in the responses to the 2016 targeted consultation as part of Task 2.2.

### 2.5.1 Legislative barriers

We have not identified any Member State in which the absence of legislation to facilitate the EETS system is in itself preventing would-be providers from entering the market. Article 6 of the 2004 Directive required Member States to bring into force laws, regulations and administrative provisions necessary for its implementation and to forward this material to the Commission. It appears that all Member States have introduced legislation at least to the extent of setting up their national electronic tolling registers listing their tolled infrastructures covered by the EETS Directive (European Commission, 2012). More specifically, the REETS project studying the implementation of EETS compliant services in those Member States which are most heavily committed to electronic tolling found there was a legislative basis establishing EETS, as well as registers of EETS domains, in Austria, Germany, France, Denmark, Spain, and Poland. We set out a number of examples of the enabling legislation and those EETS providers that are registered in several of these Member States:

#### **Austria**

Provisions relating to EETS are contained in the Federal Road Tolls Act 2002, as amended. Some of the more relevant terms of the Act include<sup>30</sup>:

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<sup>30</sup> Article 8(a)

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*Toll service providers shall comply with the obligations set out in Article 4 of Decision 2009/750/EC...*

*... Without prejudice to the jurisdiction of the courts or the authorities, the toll charger and/or the toll service provider may refer disputes arising from a contractual relationship between them, in particular alleging the discriminatory nature of the terms of the contract and on their adequacy with regard to costs and risks of the disputes to the Of Schienen-Control GmbH as an intermediary.*

*... The mediation agency shall work towards an amicable agreement between the parties. If this is not the case, it shall notify its opinion on the dispute at the latest six months after receipt of the application for mediation.*

## **France**

In France Décret n° 2011-813 of 5<sup>th</sup> July 2011 provided the legislative framework for EETS and in particular the procedure for registration as a provider. The transport section of the Ministry of the Environment publishes its register, with 18 domains currently listed in France together with details of the three French-registered EETS providers, Axxès, Eurotoll, and Total.

## **Germany**

The principle legislative instrument for EETS in Germany is the German Federal Trunk Road Toll Act (BFStrMG), which took effect on 19<sup>th</sup> July 2011. This regulates the collecting of the distance-based toll, determining which vehicles must pay toll on defined trunk roads, how the toll is collected, and how toll collection is enforced. The electronic tolling system was developed and is currently operated by Toll Collect a consortium formed by Daimler, Deutsche Telekom and Cofiroute. The only registered EETS providers are AGES EETS GmbH and the recently registered T-Systems EETS GmbH.

## **Poland**

In Polish legislation, the Act of 21st March 1985 on Public Roads, Act of 27 October 1994 on Toll Motorways (consolidated) and Regulation of the Minister of Infrastructure of 29 April 2004 on Motorway Tolls were all used to implement EETS. In Poland, there are two registered toll domains for EETS and the only operating EETS provider is Telepass SpA.

## **UK and Ireland**

Outside the REETS project, another example of the legislative underpinning for EETS is provided by the UK where the Directive came into force under secondary legislation<sup>31</sup> on 12 February 2007 following a public consultation. Supplementing the Directive, the Commission's Decision was given effect by the UK's Department for Transport in the form of published guidelines on the process for registration as an EETS provider<sup>32</sup>. However, by 2015 there were no EETS providers registered in the UK and only two EETS domain statements had been published. This lack of take-up of the EETS system probably reflects the relative absence of road tolling within the UK.

Similar legislative machinery appears to have been used in Ireland which has set up its national electronic register of toll domains pursuant to Article 19 of the Decision, and which by 2014 listed 11 domains but had no EETS providers.

It appears, however, that one factor which has caused problems is differences in the speed with which Member States have introduced legislation and regulations to facilitate EETS. For example, in Germany it appears from the website of the BAG that elements of the accreditation procedure remain subject to the possibility of amendment. It is stated that "the basis for the inspection agreement is the model of the inspection agreement, which is adopted as an annex to a legal regulation. It is expressly pointed out

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<sup>31</sup> The Road Tolling (Interoperability of Electronic Road User Charging and Road Tolling Systems) Regulations 2007 (SI 2007/68)

<sup>32</sup> It should be noted that there does not appear to be any stated requirement in this documentation that an EETS provider must cover all toll domains in the EU within 24 months.

that this is a draft and that changes in the regulatory procedure are reserved until the entry into force of the ordinance<sup>33</sup>.

Possible last minute changes of this sort clearly affect the preparatory work for entry to the market that it is feasible for potential EETS providers to embark upon. This in turn impacts the requirement in Article 4(1) of the Decision that EETS providers must enter into contracts covering all EETS domains throughout the EU within 24 months of registration.

Not only are delays in administrative procedures prejudicial to potential EETS providers, it is apparent that difficulties are also caused by the accreditation procedures in different Member States and the degree to which they differ. Examples of both these issues have been given to us by a toll service provider registered in the Czech Republic concerning accreditation in Germany. They have been in discussions with the BAG about accreditation but understand that neither the procedural requirements, nor the proposed remuneration of EETS providers, nor the draft EETS contract, nor the TDS, are ready. What they have been told, however, is that there will be more than 170 tests to pass, and the process is expected to take between 13 and 18 months.

### 2.5.2 One possible solution to these types of problem would be to lay down more precisely the necessary conditions and documentation for approvals of EETS providers outside their country of registration with the object of ensuring that accreditation in one country should so far as possible ensure rapid accreditation in others. Contractual barriers

The rights and obligations of the various parties involved in the EETS system are set out in general terms in Commission Decision 2009/750/EC. In particular, Article 5.4 requires toll chargers, being the concessionaires of tolls with electronic tolling capacity, to “*accept on a non-discriminatory basis any EETS Provider requesting to provide EETS on the EETS domain(s) under the Toll Charger’s responsibility*”. What this seeks to prevent is anti-competitive behaviour leading to distortions in the EETS market, such competition issues being of course a familiar preoccupation in the single market. Similar concerns lay behind the Commission’s 2003 Decision in Case No COMP/M.2903 DaimlerChrysler/Deutsche Telekom/JV which related to the danger of the creation of a dominant position on the part of DaimlerChrysler through the Toll Collect joint venture on the market for traffic telematics systems for transport and logistics undertakings in Germany, as a result of which effective competition might have been significantly impeded in a substantial part of the common market.

The broad contractual issues raised by the Commission in the consultation questionnaire, as well as in the interviews, include:

- a) Provisions in existing road tolling concession agreements which protect the status quo and constitute barriers to EETS entrants to the market.

Few specific provisions directly to this effect have been unearthed in our research. However, the main issue is that for the most part tolling concessions are awarded by government entities or public authorities who have been responsible for the relevant infrastructure (roads, bridges etc.). What frequently happens in practice, is that Member States permit the roles of toll charger and toll service provider to be taken by the same entity, as has happened in Belgium where the public concessionaire, ViaPass, contracted the development of the toll service platform to Satellic NV who also carry out the functions of the toll charger. Similarly in Germany the toll service provider is the same entity that was contracted by the government to develop the electronic tolling system, namely Toll Collect (the subject of the Commission’s competition decision in 2003 referred to above).

Many EETS providers and would-be entrants to the market consider that there are innumerable ways in which such mixing of functions can distort the fair operation of the market. For example, entities that combine these two roles are likely to have been involved in the development of the toll infrastructure and that this enables them to quickly move ahead of independent EETS applicants and dominate the market in the crucial early months after the EETS domain is launched and when customers are being signed up. In Belgium, as mentioned, Satellic not only

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<sup>33</sup> Our rough translation. It is also stated: “Die auf dieser Internetseite veröffentlichten Vorgaben für das EETS-Gebiet BFStrMG unterliegen bis zu ihrem Erlass mittels einer Rechtsverordnung möglichen Änderungen”.

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developed the tolling system but allegedly had their OBUs subsidised by Viapass in order to facilitate the take up of the system.

- b) Discrimination against EETS providers in tenders and in negotiations with toll chargers.

It appears that where toll chargers are served by an existing local service provider with whom they have a close commercial relationship, or who may be a related company, they can be reluctant to enter into contracts with EETS providers and therefore not provide them with a level playing field. For example, in Belgium, allegedly the necessary documentation with system specifications was only provided shortly before the EETS launch to independent toll service providers wishing to enter the market, while the national service provider, Satellic, already had this information and thus gained an advantage over potential EETS entrants. It has been estimated that Satellic now has 85% of the Belgian market for haulage users of electronic tolling.

With respect to contractual negotiations, Article 5(4) of the Commission Decision provides that “*acceptance of an EETS Provider in a toll domain shall be governed by compliance with the general conditions set out in the EETS domain statement*”. However, in the same clause the Decision recognises that further specific terms are indeed negotiable by providing that acceptance “*may also be subject to specific contractual conditions*”. Clearly, most important amongst such negotiable conditions are those relating to the remuneration of the EETS provider and it appears that in some instances toll chargers may only be prepared to allow EETS providers a similar level of remuneration to a local provider or a card issuer even though the EETS provider necessarily has higher costs. We have been told that there is an ongoing conciliation procedure in Belgium regarding this issue. Moreover, in instances where the same entity is both toll charger and service provider there is scope to obscure the cost of the service element of the overall operation costs. This can lead to undercutting independent EETS providers or to only offering unrealistic remuneration to them.

- c) The absence of any definition of the specific services to be provided by the EETS service provider and by non-EETS providers. This is a related issue to that mentioned above. It inhibits the ability of EETS providers to compare the terms offered for their services with those offered to local non-EETS service providers. A number of our interviewees, as well as responses in the Consultation, urged that tenders should be required to specify a minimum level of defined services and ensure that their respective remuneration is broken down in the bidding process. They also broadly favoured separate tenders being required for defined toll charger and toll service provider functions.
- d) Discrimination through a national service provider having knowledge of technical standards that is not made available to potential EETS entrants or where the technical EETS interfaces are not divulged by the national toll charger so as to allow functionality comparable to that already existing with the national service provider. It has been alleged in the Consultation responses alleges that in Italy the national service provider gained an unfair advantage from the lack of technical information provided to other would-be market entrants.
- e) Another unfair practice that has been alleged concerns late notification to EETS providers of technical changes to the tolling system. This is said to have happened, for example, in Belgium.
- f) Excessive toll payment guarantees being demanded by toll chargers: it appears<sup>34</sup> that EETS providers can be asked for guarantees that are not limited to a fair estimate of their monthly liability for toll remittances to the toll charger.

Action by the EC to ensure full separation of accounts between toll chargers and toll service providers / EETS providers and to secure equal rights for all EETS providers in Member State tolling markets regardless of their country of registration, could go a long way towards resolving some of the issues highlighted above.

### 2.5.3 Conciliation procedures

The mediation procedure set out in Article 11 of the Decision was intended, inter alia, as a safeguard against unfair and discriminatory treatment of EETS providers. It offers toll chargers and EETS providers the right to ask a national Conciliation Body to intervene in any dispute relating to their contractual relations or negotiations. The Commission Guidelines provide that “*without prejudice to*

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<sup>34</sup> cf. Consultation response of AGES para 2.1.3

*national legislation, a conciliation body generally intervenes at the request of a Toll Charger and/or EETS Provider.*<sup>35</sup> However, one respondent to the consultation<sup>35</sup> raised concerns that this means that only registered EETS providers can use the conciliation system and that where unfair treatment arises at an earlier stage, for example in relation to the registration process itself, the aspiring provider has nowhere to voice complaints. Furthermore it has been said that there is a risk that the conciliation system could be interpreted as only applying in relation to discrimination between different EETS providers and not, for example, to situations where a national toll charger could try to obstruct the entry of any EETS provider onto the market. In any event, in cases where the latter type of complaints are raised, it would seem that the aggrieved party's remedy would be with the national competition authority or with the European Commission.

One interviewee from an EETS provider pointed out that national Conciliation Bodies, of which there are very few established at present, may often be operating through government ombudsman services. He considered that as conciliation may be expected in many instances to be demanded between the positions of a toll charger closely associated with the government and a foreign EETS provider, however professional the conciliation procedure may be, there may remain a suspicion that the Conciliation Body was not completely neutral.

Lastly, where discrimination against EETS providers is alleged it may be doubted whether conciliation procedures have sufficient teeth to settle disputes equitably. Indeed conciliation as a concept necessarily comprises mediation between parties, as opposed to an agreed method for the settlement of disputes, as in arbitration. Conciliatory powers would therefore be expected to be limited to attempting to bring parties together to resolve disagreements<sup>36</sup>. They are not able to intervene proactively to advance the objectives of ensuring that contractual rules are 'non-discriminatory common rules and minimum requirements' applying to the EETS service<sup>37</sup>. Some respondents to the consultation have complained there is a lack of a body charged with holding the ring between the different actors and promoting the underlying objectives of the EETS system in a similar way to a regulator in other industries such as telecoms.

## 2.6 Subtask 1.6: Assess the technological and procedural differences between existing (and/or upcoming) ETC systems and their impact on the achievement of interoperability and the provision of EETS

### 2.6.1 OBU-related technical interoperability issues

The EU market for electronic tolling systems is characterised by systems that differ in terms of technical solutions and of operational procedures, making it potentially very complicated and expensive to establish interoperable ETC services.

The situation has somewhat improved since the publishing of the EETS Directive and Decision. However although ETC systems that are currently in operation mostly conform to the EETS legal framework (in particular those implemented after the Directive and Decision came into place), they have adopted different architectures and solutions, within the boundaries allowed by the legal and standardisation framework. As a result, many systems in operation today do not offer technical interoperability with each other.

We have identified a series of critical differences contributing to the current lack of interoperability, based on either different functional and technical requirements specified by the Toll Chargers or on different solutions that have been defined by suppliers and/or system integrators. Such differences exist both between and within the two main technology families (GNSS on the one hand, DSRC on the other hand).

We have classified the main issues into two broad categories covering the main parts of the value chain where technological changes could help ensure interoperability, i.e.:

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<sup>35</sup> AGES EETS GmbH

<sup>36</sup> In both Austria and Belgium there is provision for the conciliation service to issue a report, though it appears to be accepted that its views would be non-binding.

<sup>37</sup> Annex to the EETS Directive paragraph (l)

- OBU-related adaptations;
- Back-office related adaptations.

For each of these issues, we have provided a list of the potential changes which could be introduced in order to ensure interoperability across different toll charging schemes. These changes may involve changes to specific charging schemes, or potentially forcing EETS providers to adapt and modify their systems (and in particular the interoperability constituents) in order to achieve compatibility with specific ETC schemes.

## 2.6.2 OBU-related technical interoperability issues

Changes affecting OBUs are usually very demanding for EETS providers, as the continually changing market and regular introduction of new toll domains could lead to a need to continuously adapt the characteristics of their OBUs which will already have been distributed to a large number of users, circulating across Europe. Alternatively, replacement may be necessary, with significant logistics and refurbishment costs incurred by the EETS providers and their clients.

A range of toll charger specifications and/or manufacturer designs are contributing to the current lack of technical interoperability of OBUs across a wide range of toll domains, including:

- Mandatory use in some markets of a specific architecture of the tolling subsystems (in particular for autonomous tolling schemes), obliging to adopt a Thin Client or a Thick Client architecture. For example, the Belgium scheme demonstrated that two types of solution are compliant. The single service provider Satellic NV has a ‘thick’ OBU client mainly to face the requirements of the occasional users (mandatory to have the option to check the account anywhere and anytime and to inform the driver of the driven kilometers). The accredited EETS provider Axxès has a ‘thin’ client solution. The two solutions were validated by Viapass nevertheless the thin solution is a drawback in case of suspected violations because no alerts are provided to the driver. As the Belgian enforcement rules and associated fines are strictly enforced and uncapped, a new toll violation can be generated every three hours, potentially leading haulage companies and their EETS provider into difficult situations;
- Specific key performance indicators (KPIs) requiring higher performance in terms of detection of the charging points, identification of the travelled route and measurement of the travelled distance (in particular for the GNSS/autonomous systems).

As the rules are not identical from one country to another, there is a risk for an EETS provider modifying its OBUs to fit the requirements of a new toll charger. If the customer solution is impacted then an EETS provider may be obliged to go through a re-certification in a country where its solution is already certified, implying significant additional resource allocation and direct costs. The cost of re-certification can be between €10-100k per toll domain depending on the processes of the toll charger and the number of tests required. This can be considered as a major risk for EETS providers;

- Security mechanisms, obliging the adaptation of the OBU and of the overall tolling subsystem to integrate specific (non-standardised) security mechanisms, in order to ensure data integrity and traceability.

Given the lack of an agreed set of security rules across all toll domains, a toll charger can define and request specific security keys. An easier solution could be that EETS providers supply the security keys. Indeed, since their OBUs are designed to be interoperable with different toll domains, it would be easier that the definition of the security keys stems from them, and that the toll chargers integrate them into their system (it is a simple operation). The EETS providers must then only ensure that they are fully compliant with the toll charger’s requirements in terms of the level of security;

- Local type-approval requirements, obliging OBUs to achieve a specific type-approval in a Member State on the basis of a local set of constraints (e.g. higher range of operating temperatures).

One requirement of the former “Ecotaxe” project was focused on the time delay to precisely locate an OBU in a very short time after the OBU is switched on. Such a constraint has a direct impact on the design of the OBU and a toll charger should not have the authority to define such a level of detail of the design of OBUs. Indeed, if such a requirement is introduced for a new tolling scheme, it may impact OBUs already in operation in existing toll domains;



- Customisation of the Compliance Check Communication (CCC) interface, using the DSRC interface within the OBUs to implement verifications for enforcement purpose, as the vehicle passes in close proximity to the roadside enforcement equipment. Here, some Member States specify functional requirements according to which the OBUs must transmit a much broader set of data (including potentially personal data) across this interface, well beyond those indicated by the EN 12813 standard (Compliance Check Communication for Autonomous systems);

Analysis of the first existing version of BVMI/BAG requirements for EETS provider certification highlighted that regarding ISO 12813, some non-classic attributes and functions are requested. Whilst these attributes are referenced in the latest standard and EETS providers can include them into the design of their new OBUs, this is not the case for existing OBUs. Thus an EETS provider which already has large numbers of GNSS OBUs in operation on DSRC and GNSS toll domains could be prevented from operating in Germany even if its solution is compliant. The reason is that modifying the setup of the OBU requires it to be sent back to the manufacturer, which is impossible from a logistical and cost point of view for such a large number of OBUs. A suggestion could be to have a special dispensation for the case of already-certified OBUs, whilst still requiring EETS providers to make new OBUs compliant.

- Requirements for real-time information on account balance, price of given road segment, etc. to be displayed on the screen of the OBU for the benefit of the truck driver. This not only increases the complexity of the solution, but can become a nuisance for frequent drivers who do not wish detailed information to be displayed on a regular basis.

Addressing the above issues would go a long way towards ensuring better technical interoperability of OBUs across multiple European toll domains. However, any changes to OBU specifications will need to be gradual to avoid large-scale disturbances to existing schemes and extensive costs to EETS providers.

### 2.6.3 Back-office system-related interoperability issues

Changes affecting EETS providers' back-office systems generally have significantly less impact than those involving changes to OBUs. Whilst significant investments may still be required, the overall economic impact should generally be lower as changes must be implemented in only one location. Typical changes required include changes to interfaces with toll charger systems, or transaction processes / business rules implemented within the back-office of the EETS provider.

A range of issues are contributing to the current lack of technical interoperability of back-office systems across a wide range of toll domains, including:

- The need to calculate specific tariff schemes by implementing tariff tables and specific criteria that apply on different toll domains, when the EETS provider is required to do so, for example in Belgium tolling of HGVs is calculated using vehicle categories based on maximum laden weight, whereas elsewhere categories are based on the number of axles;
- The requirement of specific interfaces imposed / required by toll chargers on top of pre-defined system architectures (e.g. in case the toll charger requires the exchange of specific data points which other toll chargers do not require);
- The customisation of back-office interfaces in the absence of a mandatory set of specifications.

Addressing the above issues would go a long way towards ensuring better technical interoperability of back-office systems across multiple European toll domains. Clearly any changes will incur a cost to the EETS provider, but these costs may well be lower than making wholesale changes to OBUs (assuming that the changes can achieve the same overall outcome).

## 2.7 Subtask 1.7: Assess remaining gaps in the standardisation framework

This section provides an overview of the existing standards for ETC related to EETS, as well as identifying potential gaps which should be addressed to ensure a successful implementation of EETS.

### 2.7.1 The existing electronic tolling standard framework

Figure 2-7, from the ISO 17573:2008 standard<sup>38</sup> shows the roles and responsibilities in a generic Electronic Fee Collection System. Whilst there may be cases where all responsibilities in this framework are carried out by a single entity, in the case of EETS, multiple entities will assume the different responsibilities (and several different equipment providers may also be involved).

In order for such a system to be able function effectively, clear standards are required to define all the interactions between the various roles and responsibilities described in the framework. These standards should be defined, applied, and possibly enforced (e.g. via legislation), not only for technical information exchanges, but also for human/regulatory interactions, e.g. for management of the overall system.

**Figure 2-7: Roles and responsibilities in a tolling environment**

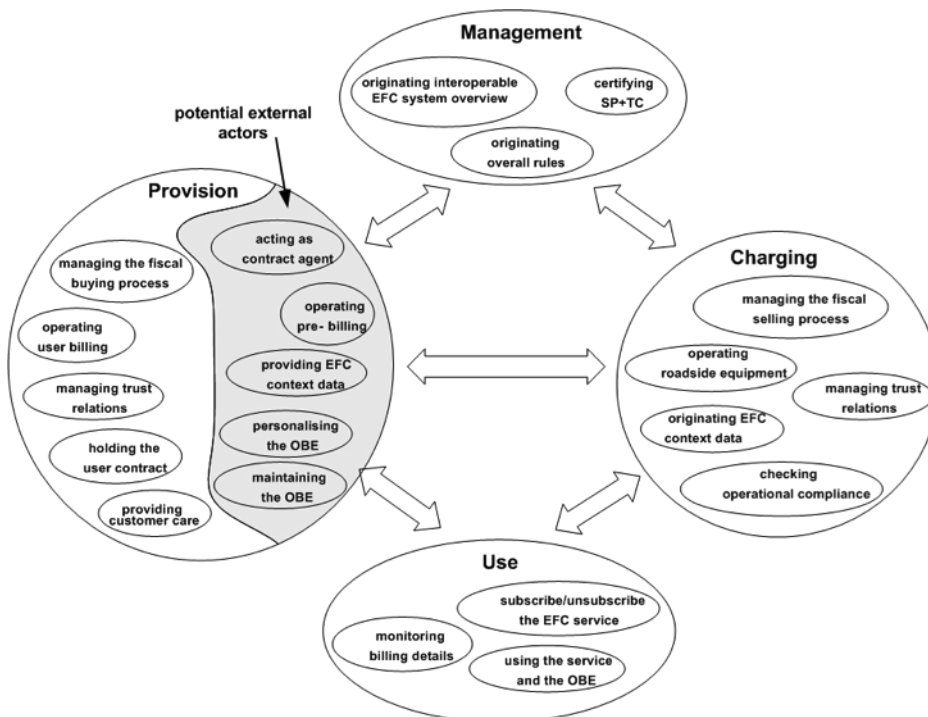


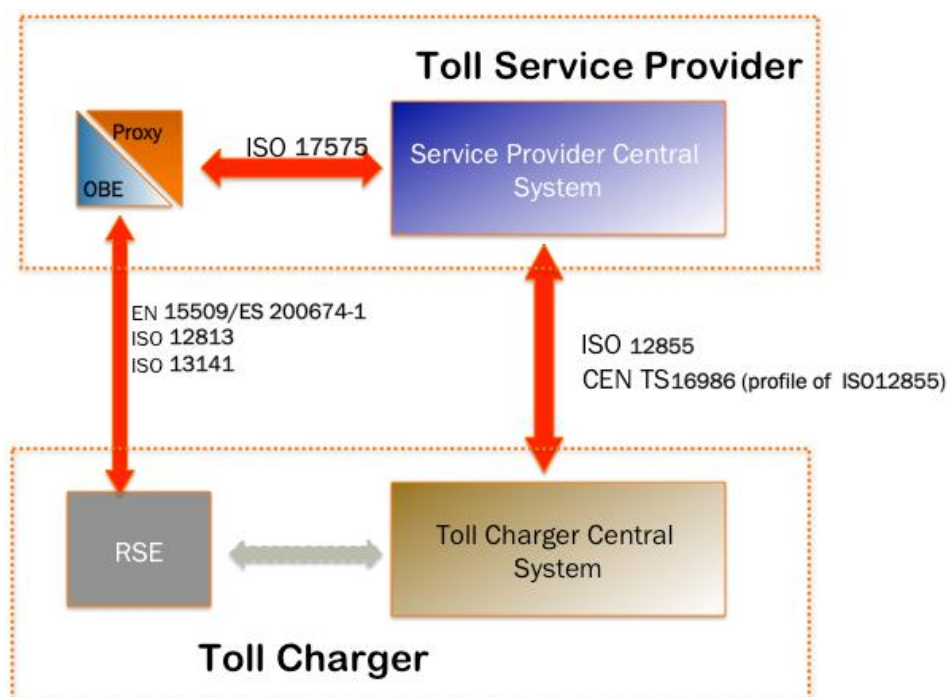
Figure 2-8 shows the technical architecture implied by EETS, where the two roles of Provision and Charging identified in Figure 2-7 are implemented by the Service Provider and Toll Charger respectively. It also summarises the existing standards referenced in the legislation<sup>39</sup> and associated guidance such as the Guide for the Application of the Directive on the Interoperability of Electronic Road Toll Systems<sup>40</sup>.

<sup>38</sup> Road Transport and Traffic telematics – Electronic Fee Collection – System Architecture for Vehicle Related Tolling

<sup>39</sup> Directive 2004/52/EC and Decision 2009/750/EC

<sup>40</sup> [https://ec.europa.eu/transport/sites/transport/files/media/publications/doc/2011-eets-european-electronic-toll-service\\_en.pdf](https://ec.europa.eu/transport/sites/transport/files/media/publications/doc/2011-eets-european-electronic-toll-service_en.pdf)

Figure 2-8: The EETS technical architecture and related standards



This figure is bound to the EETS legislation, in that it considers only the technologies mentioned in it, namely DSRC at 5.8 GHz and GNSS. The figure also shows standards (ISO 12855, ISO 12813, ISO 13141, and ISO 17575) that are not mandated by the EETS legislation, although some of them feature in the Decision 2009/750/EC.

### 2.7.2 How standards are set for the implementation of EETS

CEN, ETSI and CENELEC are European recognised standards bodies (independent of the EC). Standards support agreements, public procurement, European policies and legislations. Standards are in general voluntary. EFC standards have a broader scope than the EETS and are jointly developed by CEN and ISO.

The legislators decide on the legal status of standards. Currently, only limited standards are referenced in the EETS legislation;

- EN 15509 and ETSI ES 200674-1 for DSRC,
- CEN ISO/TS 24534 for vehicle parameters (superseded by EN ISO 14906:2011 and EN 15509:2014)
- EN 45000 series of standards for the accreditation of notifying bodies (EN 45111 has been withdrawn and replaced by EN ISO/IEC 17065)

The governance and the maintenance of the definition of EETS through relevant and current standards is essential for a proper definition and a definition that is fit for purpose over time.

According to the Directive (Article 5), technical decisions relating to the realisation of EETS shall be taken by the Commission, assisted by the Toll Committee in accordance with Committee procedure, which itself is based on Regulation (EU) 182/2011. The latter lays down the rules and general principles concerning mechanisms for control by Member States of the Commission's exercise of implementing powers.

The activities of the NB-EETS Coordination Group (CG) take place under the authority of the Toll Committee set up by the EETS Directive. The remit of the NB EETS CG is limited to technical problems relating to conformity to specifications and suitability for use assessments. The aim is to ensure a uniform application of the technical provisions of EETS legislation and that all EETS Notified Bodies (NBs) carry out their work of assessing the conformity to specifications and suitability for use of EETS interoperability constituents in an equivalent manner. The NB EETS CG documents tasks and ways of

working in the form of ‘Recommendations for Use’ to be approved by the Commission according to the procedure foreseen in Article 5(2) of the EETS Directive.

Specifically, the NB-EETS CG is expected to:

- Define, publish and maintain an up to date list of applicable documents (including references to standards) that contain the requirements and the associated conformity assessment tests;
- Define and publish a list of required documents to sustain the Declaration of Conformity (DoC) for EETS providers; this list supports the national registers that are responsible for verifying the validity of the statements by candidate EETS providers;
- Define, publish and maintain a set of common criteria applied by NBs for the NBs’ statements, with the aim of achieving equivalence of working practices and ensuring a level playing field.

However, whilst the basic principles for maintaining the various documents, lists and criteria over time are in place, they are not being used effectively.

### 2.7.3 Standards relevant to EETS

In addition to the standards referenced in the existing EETS legislation, several other standards that are essential for a proper interoperable implementation of ETC in the EU are available, but are not mandated by the European legislation. Figure 2-9 gives a complete picture of the most important relevant CEN standards for Electronic Fee Collection, covering DSRC, GNSS (autonomous) and back-office systems (technology-independent), including both requirements standards and compliance test standards.

Figure 2-9: The CEN Electronic Fee Collection standards

	DSRC-based EFC		EFC-tech. independent	Autonomous-EFC	
	Tests	Requirements		Requirements	Tests
<b>Frameworks</b>	14907-1 Test Procedures		17573 EFC Architecture 17574 Security Profiles 19299 Security Framework		
<b>Toolboxes</b>	14907-2 DSRC-OBUs Tests	14906 AID for DSRC-EFC 25110 AID, IC-cards 16875 Interface OBE+	12855 Info Exchange 17444-1/2 Charging Perf. Indic.	17575-1/2/3 AID Auto.-EFC 16702-1/2 Sec.Mon: CC & TR	16401, etc Auto-test (3*2 parts)
<b>Profiles</b>	15876-1/2 IAP Test	15509 IAP for DSRC-EFC	16986 IAP for Info Exchange	16331 IAP for Auto-EFC 12813 CCC for Auto-EFC 13141 LAC for Auto-EFC	13143-1/2 CCC Test 13140-1/2 LAC Test
<b>Technical Reports</b>		16040 Urban DSRC 16968 Security assessment	16152 First Mount OBE 16092 Pre-Paid Req. 16219 Value Added Serv. 16690 EFC on ITS stations 19639 Common payment schemes		

In addition to the CEN standards, the EETS legislation includes the possibility of using the ETSI ES 200674-1 standard (as used in Italy), defined by the ETSI ITS Technical Committee and commonly referred to as High Data Rate DSRC (HDR-DSRC). The set of HDR DSRC standards is represented in Figure 2-10, again covering both requirements and compliance test standards.

Figure 2-10: The ETSI HDR DSRC standards

	Test	Requirements
Frameworks		17573 EFC Architecture  19299 Security Framework
Toolboxes	ETSI TS 102708 Test specification for HDR DSRC	ETSI ES 200674-1 HDR DSRC
Profiles	ETSI TS 102708 Test specification for HDR DSRC	ETSI ES 200674-1 Annex D European Profile

As can be seen from these two figures, both sets of standards share a common framework, i.e. the general EFC Architecture standard CEN TS 17573 and the Security Framework standard CEN TS 19299. All technology-independent standards – outlined in the middle column of the “The CEN Electronic Fee Collection Standards” scheme - are applicable in both environments.

In addition to the above list of standards, among the standards already published related to electronic fee collection, it is worth mentioning the CEN TS 16702 standard that integrates the following two documents:

- CEN TS 16702-1:2014 “Electronic Fee Collection - Secure monitoring for autonomous toll systems - Part 1: Compliance checking”
- CEN TS 16702-1:2014 “Electronic Fee Collection - Secure monitoring for autonomous toll systems - Part 2: Trusted recorder”

These two standards specify the characteristics of the so-called Trust Recorder, a module that Toll Chargers may require in their specification when planning the introduction of an autonomous toll system. The Trust Recorder is a module within which the raw road usage data (e.g. positions, speed, etc.) as registered by the OBU may be recorded and maintained in a secure way. Part 1 of the standard specifies the interrogation of this equipment via DSRC 5.8 GHz, Part 2 specifies the functional characteristics of the equipment itself. These two standards may have an impact on EETS in cases where certain toll chargers require EETS OBUs used on their network to be equipped with such a module, or if this module is imposed by regulation (not recommended).

There are then some other standards that are being developed and/or validated and that are planned to be published in October 2017; they include:

- CEN TS 21192, with regards to traffic management by means of tariff modulation;
- CEN TS 21193, with regards to the use of common payment systems (such as those used for public transport) with the aim of ensuring integrated payment schemes;
- CEN TS 21719, with regards to OBU personalisation via DSRC.

Among the above mentioned standards, it is worth highlighting that the standard TS 21193 is very much sponsored by Asian countries being active within the ISO TC 204 committee, and provides the basis to ensure payment means integration between tolling schemes and other public transport fare schemes (very much as it is already the case in countries like Japan and Singapore). The architecture in this case includes the possibility of a clear separation between the technical OBU and the payment means, which is represented by an IC card to be used within the OBU (for tolling and other vehicle-based services) or separate from the OBU (for person-based services). This kind of integration (or interoperability among different payment services) was considered in Europe at least 10 years ago when manufacturers and system integrator were pushing for OBUs to be able to handle pre- or post-paid smart cards, but it has never been implemented because the required investments (in particular increased OBU costs) were not compatible with the market demand for such an integration. In order for such an approach to be feasible in Europe (e.g. for light vehicles), the overall business case would need

to be proved, i.e. the necessary investment should be balanced by corresponding revenues / savings in service provision; this is often not the case as service providers are clearly separated.

It should be noted that CEN/TC 16331 on interoperable application profile for autonomous (GNSS) systems is currently being revised. The intention is to offer a small set of coherent profiles based on underlying standards, which are needed to establish compatibility with currently deployed ETC schemes in Europe. The revised 16331 will offer a much more solid reference point for ensuring interoperability than the first edition for interoperability of autonomous systems. The next edition is expected to be published in 2018. This Technical Specification defines a set of interoperable application profiles suitable to be used for defining the overall functionality of an interoperable ETC cluster (i.e. a group of toll charger and toll service providers, very much like EasyGO) using autonomous vehicle equipment. Doing so, it also defines a way of defining further profiles for future use. The profiles cover a wide range from simple toll road systems up to very complex tolling principles and tariff rules. An ETC cluster can select and use one of these profiles covering the needs of all participating toll chargers. The scope is limited to base standards defining data elements or messages, as required when defining the data exchange protocols for autonomous tolling. This covers ISO 17573 and the base standards CEN ISO/TS 17575 parts 1 to 4, CEN ISO/TS 12813, CEN ISO/TS 13141 and those parts of EN ISO 12855 specifying messages which are only relevant for autonomous systems.

Finally, it appears that it is not permitted for the EETS legislation to recognise relevant standards as 'harmonised' standards, as by definition harmonised standards are voluntary based on the definition in 'new' standardisation regulations. Nonetheless, the newest relevant EFC standards include an informative annex on the "Use of the standards for EETS", including the linkage between the provisions of the standard and the essential requirements in the EETS legislation. Other informal options for referencing standards include publishing lists of recommended standards as part of an online service on how to implement EETS – for example as part of the Application Guide (and future updates to it).

#### 2.7.4 Gaps in legislation and regulations

As discussed above, only a small number out of the whole set of standards relevant to EETS are referenced in the legislation. Whilst it is not essential that all standards mentioned above are mandated, there are some gaps in the current legislation, namely:

- 1) **Testing standards** - Although a committee has been created to harmonise the activities of the Notified Bodies for certification of the interoperability components of EETS, no EU legislation imposes the adoption of the testing standards that are defined by the EFC Working Group within CEN and by the ITS Technical Committee within ETSI. In general the same Notified Bodies search for commonly agreed standards to perform their validation tests, as they usually do not have the necessary competences to develop their own test procedures. As a certificate of conformity issued by one of these European Notified Bodies is considered valid across the entire EU, it is recommended that harmonisation of test procedures is achieved. Whether this should be achieved by means of coordination activities among the interested parties or by means of the imposition of a standard should be defined and possibly specified within the new EETS legal framework.
- 2) **Security** - No mention of the Security Framework defined in CEN 19299 is made by the EU legislation. The framework defines the technical security countermeasures to be adopted when a given security policy is defined. The definition of a security policy for an international service like EETS should be defined at super-national level, but it is not defined in the EU legislation or regulations. A general security policy at European level would be practically very difficult to define, unless this is developed in the frame of specific projects (such as REETS) and then adopted as a kind of de-facto standard. It is recommended that the Commission should take the role of "imposing" such security policy at EU level.
- 3) **Profiles, not toolboxes** - Standards are generally full of options, in order to cope with different requirements. To improve interoperability, standard profiles are defined, which should be mentioned in the legislation instead of general standards (toolbox standards in the above figures). While this approach has been used for CEN DSRC based interactions (EN 15509 is the only example), the reference to other standards in official EU documents like the Guide for the Application of the Directive on the Interoperability of Electronic Road Toll Systems is of toolbox standards, not of profiles. Profiles that need to be mandated by legislation are:

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- a) Information Exchange. The standard ISO 12855 is widely quoted (but not mentioned in the EU legislation). Instead, its profile CEN TS 16986 should be included and mandated.
  - b) Profiles for autonomous charging. For tolling systems where autonomous On Board Equipment is used (e.g. for GNSS / satellite-based systems), at least two standards are essential:
    - i) Compliance Check Communication. The commonly called CCC standard (ISO 12813) is for Toll Chargers to check that On Board Equipment traversing its domain is indeed compliant to regulation. However, the ISO 12813 standard has to-date been differently interpreted by the different players on the market and several toll chargers have implemented solutions which require the provision of several additional private data attributes from the OBUs (on top of those defined by the ISO 12813 standard), thereby affecting interoperability with OBUs already distributed on the market. Standards need to be more specific and avoid the possibility for system integrators to select different options that prevent technical solutions to become interoperable.
    - ii) Location Augmentation. The LAC standard (ISO 13141) is for Toll Service Providers to get accurate positioning on their On Board Equipment.
- 4) **Autonomous systems / GNSS standards** - The standard ISO 17575 parts 1, 2, and 3 are widely referenced but not directly mentioned in the EU legislation. The most important element of this standard are the ASN.1 data types that it defines, which are referred to by other standards. Therefore instead of including ISO 17575 as a whole, a suitable (set of) profile(s) like those in the CEN TS 16331 should be mandated. This is important even if it seems to concern the internal processes of EETS providers; indeed it is important to ensure technical interoperability across the end-to-end processes (i.e. beyond the mere interfaces between the OBU and the Proxy).

### 2.7.5 What is missing in the existing standards

The published standards (and those under revision) described above provide a solid support for EETS.

Nevertheless, the existing standards often have a full set of options (allowing for example the choice of data attributes out of a large list) that real life implementation has shown to be redundant. This redundancy is a real issue when looking at data types which are independently defined by different standards (different standards define the data type structure for certain attributes required as part of EETS). A common library of definitions of terms and data types for the set of EETS basic standards is a clear requirement for ensuring future interoperability. The use of versions (akin to release planning), where a version is defined as a coherent set of standards or profiles, that taken as a whole, ensure a working and interoperable implementation of an EFC system, is currently missing.

A clear EU policy favouring interoperability should lead to drastically reduced numbers of options by specifying a limited number of profiled solutions. The profiles that are available at the moment represent a step in the right direction, but should be optimised towards a minimum set for interoperability.

Furthermore, there is a need to maintain the standards in order to make sure that they reflect current user and policy requirements and technical innovation. As an example, the revision of several base standards is being undertaken and will, amongst other changes, incorporate recommendations of the European Union Agency for Network and Information Security<sup>41</sup> with regards to encryption algorithms and key length. Hence, updated EFC standards will be extended to include also AES (advanced encryption standard). It is expected that the next edition of the profile standards will also include an 'AES profile'. However, it is up to the users of the standards and EETS legislators whether to adopt such a future standardised profile.

Hence, it will be key to govern the evolution of requirements through time, based on the evolution of standards and technology. The basic framework of the process for managing this evolution is already in place, so we should make use of that:

- The Commission decides on the technical decisions relating to EETS implementation, assisted by the Toll Committee

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<sup>41</sup> <https://www.enisa.europa.eu/>

- The NB CG advises the Toll Committee on tasks through 'Recommendations for Use', e.g. updates to the applicable standards for EETS, with the aim of achieving equivalence of working practices and ensuring a level playing field.

In order to maintain the definition of EETS, the definition should reference new versions of applicable standards (e.g. based on a version release concept), where necessary, and the older versions should at some point in time cease to be applicable, after a transition period. The obsolescence of the standards can be handled by defining different releases (very much like in software development), with each release ensuring compatibility with one or more versions of same technical standards. When planning the revision of a technical standard that is referenced by the EETS legal framework, standardisation bodies should be required to implement the necessary changes and updates in a way that ensures continued compatibility.

Certain standards (for example those regarding mobile communication between a GNSS OBU and its proxy) are not required to be strictly specified and may remain within the responsibility of EETS providers themselves. It will be up to EETS providers (when specifying and planning their own interoperable constituents (including OBUs)) to select the most appropriate technology for the expected lifetime of the OBUs. EETS providers will decide based on economic, strategic and market criteria whether to select GPRS over UMTS (today this implies about €30 more per OBU) or other communication means.

Finally, electronic tolling projects and research projects such as REETS have also underlined a number of obstacles to the deployment of a full pan-European EETS system and further areas for potential improvements. Table 2-13 summarises identified issues in various areas, together with suggestions for improvements.

**Table 2-13: Summary of additional suggestions for improvements to the EETS standardisation framework**

Area	Suggestion	Rationale (detected issues and gaps)
EETS OBU	Clear reference to how a EETS OBU should be specified (3 and / or 2 technologies) in order for a service provider to qualify as an EETS provider	<p>Currently, many EETS providers provide their services by using OBUs that are not compliant with the requirements of the Decision 2009/750/CE (i.e. EETS three technologies):</p> <ul style="list-style-type: none"> <li>• DSRC CEN EN 15509</li> <li>• DSRC ETSI 200 674-1 (alternative technology possible only for Italian Toll Domains)</li> <li>• GNSS</li> </ul> <p>In some cases EETS Provider use 'degraded' OBUs containing only two of the three technologies. However, service providers are qualified as EETS providers if they have a subset of the three technology modules inside their OBUs. This aspect should be clarified in order to prevent issues with interoperability.</p>
Documentation	Create a European reference list of the standards to be used in the EETS environment.	A clear exhaustive list of all mandatory standards to be used for EETS should be published, in order to better understand how to be compliant with the regulations (example the ISO 14816, which is referenced in other standard documents).



## 2.8 Subtask 1.8: Provide a comparison of the practices of accreditation of EETS providers, and identify best practices

### 2.8.1 Overview of key findings

We have assessed the certification procedures for EETS providers in five Member State toll domains: TIS-PL in France, Telepass in Italy, ASFINAG in Austria, Viapass in Belgium and LKW-Maut in Germany. Full details of each individual accreditation procedure can be found in Annex A.

The outcome of the assessment showed that processes for accreditation vary significantly from one Member State to another. Key points to note include:

- There are two separate parts to accreditation procedures:
  1. The **Contractual** part: the EETS provider must negotiate a contract with all toll chargers in the domain(s) to be covered, e.g. 21 contracts with toll chargers in France and 27 contracts with toll chargers in Italy.
  2. The **Technical** part: the certification is mostly structured as follow: a) technical presentation of the solution and compliance demonstration with toll charger requirements and relevant standards; b) laboratory tests including interface tests; c) end-to-end tests; and d) Tests in operations (limited number of OBUs during a limited period of time).
- Depending on the type of technology required (DSRC or GNSS), the type of tests will be adapted in accordance. However, the back-office interface between the toll charger and the EETS provider is based on the ISO 12855 standards (as specified in the EETS legislation) regardless of the technology used.
- The duration of accreditation procedures varies significantly between markets, ranging from 16 to 20 months for TIS-PL accreditation (France – 19 toll chargers) and Italy, to 13 months (minimum) for Germany, to as little as 6 months for Belgium.
- All the toll chargers request a fee to cover their expenses during the certification process, again these vary considerably between markets: for example €220k for Viapass in Belgium, €350k for the French toll chargers, no official information for Germany, etc.
- The varying experience of toll chargers is also a major source of variation in accreditation procedures:
  - There are differences when the tolling system is already in operation or is about to be.
  - When the toll charger has existing experience of operating ETC systems and background with either a single service provider or with EETS providers, the process is generally significantly more precise and well defined.

### 2.8.2 Conclusions on certification

Today, it is feasible for an EETS provider to be accredited in the five toll domains assessed in Task 1.8 using a single interoperable OBU. However, even if the EETS provider has the resources to lead five accreditation projects in parallel, they will need at least 24 to 30 months to achieve full interoperability with a new OBU. The total cost of accreditation for the five countries will be between €6-8m (including the cost of EETS provider technical and legal resources and the accreditation fees charged by toll chargers). Clearly therefore this lengthy timescale and significant cost represent a significant barrier to entry for new EETS providers looking to enter multiple markets at the same time (and when attempting to comply with the EETS Decision's obligation to cover all 140 EU toll domains within 24 months of registration).

Nevertheless, despite this complicated and costly process it is apparent that most toll chargers have defined three main common steps for EETS provider accreditation, namely:

1. EETS documentation review (tailored and detailed demands which are different from one toll charger to another). The OBU CE marking seems to be one of the few common requirements.
2. Suitability to use tests, although again this differs from one toll domain to another. Moreover the end-to-end test must be performed in the local operating environment.
3. Operational tests with a fleet of test vehicles.

Going forward, a common accreditation procedure defined in the revised EETS legislation would be desirable, based in part on the above common steps, alongside guidelines for approximate timescales and/or costs. However, future normalisation efforts may be limited due to the fact that it is unlikely that any organisation (even a pan-European one) will accept the risk of lost toll revenues in the event of incompatibility, on behalf all EU toll chargers.

One other major potential issue for an EETS provider is the re-certification process required due to any change requested by a toll domain that may have an impact on the EETS system, for example system upgrades, deployment of new roadside gantries, etc. In these cases, EETS providers may be requested to re-certify their OBUs and systems in the toll domain where it was previously certified as interoperable, at significant expense. The reviewed directive may also include recommendations on how best to limit the impacts of such changes on EETS providers.

Other specific recommendations for limiting the effort required in accreditation and certification of EETS providers are provided below.

### **DSRC toll domain**

DSRC is a mature technology. If a DSRC OBU is certified for a toll domain, it should be compliant with most of the other DSRC toll domains. Nevertheless, toll chargers currently check that the OBU is compliant with all the DSRC gantries or toll gates on their network, given they are not based necessarily on the most recent technology. For example, some DSRC beacons may request more time to respond than others and the DSRC may consequently need to be fine-tuned. Going forward, simpler solutions could include:

- The European DSRC toll chargers could decide that as soon as a DSRC OBU is certified by one toll domain, other toll domains are only allowed to request a successful lab test to demonstrate compliance with all their DSRC beacons.
- Another possibility is that a European body could collect all the European DSRC profiles and simulate DSRC tests that could help the manufacturer to prepare for certification in different countries.
- Interface tests are specific to each toll charger and the standard 12855 version 2015 facilitates the development of re-usable use-cases.
- Finally, for trial and pilot operations, rules are set by the toll charger, but one suggestion is to limit these test phases to 6 months in total.

### **GNSS toll domain**

In order to facilitate EETS accreditation, the validation of the OBU CE marking dossier should be carried out once for all GNSS toll domains. This process is purely one of documentation by toll chargers due to the fact that they are not able to carry out dedicated tests.

Additionally, with the advent of the ISO 12855 standard version 2015 and the CEN/TS 16896:2016 standard describing the interoperability profile to be used, the maturity of GNSS technology and its applications have been demonstrated. Based on this, the suitability for use tests will also become standard, thereby facilitating EETS accreditation due to the re-usability of the tests for different toll domains. Ideally ISO 12855 version 2015 and the CEN/TS 16896:2016 should be mandatory for any new or updated toll domains.

## **2.9 Subtask 1.9: Assess how the legal classification of tolls affects the business case and administrative hurdles for EETS/independent toll service providers**

The issue which flows from the legal classification of tolls is essentially that where national or local legislation classifies tolls as taxes the toll operator becomes in effect a tax collector. In these circumstances the EETS provider is regarded as a collection agent. On the other hand, where tolls are not classified as taxes, the toll represents payment for a service and the EETS provider can be regarded simply as a sub-seller. Hence the description of the alternative business models as either the 'agency model' or the 'reseller model'. One important practical consequence of this distinction is that where tolls are collected as taxes in principle no VAT is payable, whereas the contrary is the case where a service is being provided. Additionally, for the agency model the EETS provider cannot directly issue an invoice

to the road user and must issue a separate statement, with the invoice coming directly from the tax authority – thereby complicating the overall toll collection process. This is not the case with the reseller model, where simple VAT invoices can be used between all the actors in the value chain.

The kind of complications which these distinctions give rise to are illustrated within Belgium. The three regional authorities concerned in the tolling system differ in their categorisation of tolls, two regarding them as taxes and one as service remuneration. The different treatment of VAT between these regions has created enormous difficulties for EETS providers in designing a common billing system covering all toll domains within Belgium. In this respect, Belgium presents in microcosm difficulties that providers face in creating a uniform billing system for their customers covering the whole EU.

Another relevant example is in France, where the now defunct Ecotaxe project was categorised as tax revenue mainly due to the fact that revenues from the Ecotaxe were not only allocated to the road budget (which is a condition for a classification as service fee in France) but were also used to finance new transport infrastructure including truck and rail projects. The second reason was that the classification as a tax allowed France to involve customs in the project, whose responsibilities were extended to control and enforcement of the road users. For EETS providers who were already operating under a service fee regime for the different toll domains that they cover, the management in parallel of the Ecotaxe would have introduced a number of additional constraints. In particular, due to the specific security requirements implied by the management of a tax, the user positioning data collection process would have become very complex and a dedicated data channel would have been needed.

It has also be pointed out to us that in countries where the toll is regarded as a tax and the agency model has to be adopted the EETS service provider may be required to abide by the requirements of the Second Payment Services Directive (PSD2) and be licenced as a financial institution. In the REETS project this was a difficulty said to have been faced by German providers wishing to operate in Austria. One interviewee told us that his company was considering whether they would need to license a subsidiary in order to operate wherever the agency model was required.

Further complication arises with respect to the legal classification of tolls as taxes or not, insofar as toll recovery is concerned. Specifically, different national data protection laws treat the handling of personal data (and its potential sharing across borders where necessary) differently for criminal vs. civil cases. This is relevant because whilst tax evasion may be treated as a criminal case in some jurisdictions, evasion of a service fee may be treated as a civil or administrative issue. As such, the classification of tolling fees as taxes or not can have an impact on the ability of toll chargers or EETS providers to recover unpaid tolls due, both within the Member State where the offence occurred and elsewhere.

Clearly based on the issues outlined above, there are significant complexities associated with EETS providers unifying the very different tax and service fee regimes required in different toll domains into a single contractually, technologically and procedurally interoperable system. Many legal and contractual barriers are likely to be encountered which take time and investment to overcome and could force the EETS provider to design a system that is better suited to either the tax or service fee regimes.

An additional clear requirement that would be useful to set out in any updated legislation for toll chargers is to list all the data fields and information that must be provided in the invoice, thereby facilitating to some extent market entry for EETS providers.

## 2.10 Subtask 1.10: Assess links to personal data protection

### 2.10.1 Issues related to design of EETS systems due to differing national data protection regimes

Currently EETS providers need to comply with different data protection standards when they want to establish and provide services in any Member States. Those standards are currently regulated by Directive 95/46/EC which leaves a margin to Member States in defining the precise measures to be taken by EETS service providers. To provide examples, the contractual relationships between customers and EETS providers, data security standards and data retention periods all differ from Member State to Member State. This discrepancy is related to the margin that the Directive grants to Member States in relation to those aspects. The Directive provides that data security standards shall be appropriate to costs as well as to risks to the protection of personal data. Furthermore, the Directive also holds that data shall not be kept longer than necessary. Logically, this formulation grants a margin to Member States in defining the standards.

For example in Germany, data security safeguards are based on the federal German data protection law and this is based on Directive 95/46 being implemented into national law. Section 9 of Federal Data Protection Act and Annex define the regulations and conditions for data security. On this basis, the Federal Office for Road Transport provides more detailed guidance to potential EETS providers on how they can meet data security requirements. Providers would need to be able to prove safeguards in order to provide their service in Germany. So far, for varying reasons, no foreign provider has applied to the BAG in order to provide their service in Germany.

In other countries (for instance in the UK and France) data protection risk assessments are conducted by applying different models. These different risk assessments could lead to different outcomes (e.g. low vs. medium risk). For example, fiscal authorities may want to re-use data for tax purposes (e.g. traffic taxes), or for data mining, big data or fighting crime. In some MS this may be assessed as low-medium risks, whereas elsewhere it may be assessed as high risk. This would require different mitigating measures to protect data subjects in some MS. This in turn could lead to different requirements for storing or transmitting data and therefore different technical solutions from EETS providers and toll chargers.

In Belgium, ISO standards are used for technical data security safeguards. Both SSP and EETS providers must be compliant with the following aspects in order to be certified: ISO 17575 open box communication; ISO 17573 for the architecture including the back office system; ISO 12855 Exchange of data between service provider and back office protocols; ISO 12813 Enforcement systems. All of those standards contain sub-standards defining how the data can be used at each stage of the process.

Many respondents to Question 14 of the Task 2.2 targeted consultation mentioned that the GDPR which will enter into force in 2018 will be a positive development since it will harmonise many of the currently diverging standards between Member States. However, whilst the GDPR is expected to bring data protection under a common umbrella across the EU from 2018, it could still allow some flexibility on certain aspects. For example for the risk-based approach used to assess the impacts on the privacy rights of data subjects, there may be differences in interpretation of the risk profile between Member States, thereby leading to differing data handling protocols and potential interoperability issues. It has therefore been suggested that it would be useful if the Commission issued a best practice document on data protection in the tolling sector in conjunction with the GDPR. This would reassure DPAs on how best to come to a common approach on data protection in the sector.

Furthermore, in other cases, Member States regulate data protection only partially via their national transposing law of the Data Protection Directive. For example, in Germany two national laws regulate the tolling system and respective data protection standards: Bundesfernstrassenmautgesetz and Mautsystemgesetz. These two laws prevail over the Data Protection Directive and the GDPR. The former law generally determines the data protection and privacy in relation to the tolling system while the Mautsystemgesetz regulates the approval process of EETS providers. These two laws only apply to toll data for trucks and no tolling system exists in Germany on Federal National Roads that applies to private cars. The tolling system in Germany places very strict limits on data handling. Most notably, in Germany, data cannot be used for any other purpose than for toll billing. In other countries this data can in exceptional cases be used for other purposes such as for the investigation, detection or prosecution of criminal offences or for tax purposes. Up to now there has been no serious attempt to change the strict purpose limitation of the data. The German tolling legislation does not provide for the sharing of data with other MS, but since only German-based companies can be approved under EETS legislation, there is no need for cross-border data sharing of tolling data and so German data protection law would apply. However, German data protection laws would still prevent data sharing for the purposes of toll recovery where cross-border data transfer may still be required.

In Belgium the purpose limitation principle in relation to tolling data is not set out very clearly in the applicable law. Therefore, it is not clear whether the data can be used for additional purposes. However, the Belgian Privacy Commission has allowed that anonymised vehicle data can be used for traffic flow information. Furthermore, currently a test case is being setup to use anonymised vehicle data for parking real time information. Anonymised vehicle position data used for traffic flows are held in a "bucket server" which only holds a certain amount of data and therefore is deleted when more data is added. All data is therefore deleted in less than 12 hours. However regional traffic centers can access the data and download it to their own servers. They have applied separately to the privacy commission for using this data and will have defined how it can be used within their application. To make alternative data uses of non-anonymised data possible (e.g. for the investigation of crime, etc.) would require a

change in the Belgian law. The Belgian government is keen to use the tolling data for multiple purposes so a change in legislation is likely to happen.

As shown in the preceding paragraphs, even after the GDPR enters into force, additional more specific laws on data protection with regards to tolling in Member States could place more stringent requirements on EETS providers in some countries (i.e. in Germany) thereby implying potentially more complex, or different systems that are not necessarily interoperable with those in other markets. This could present barriers for EETS providers to provide their services in some Member States.

## 2.10.2 Issues related to cross-border enforcement of toll payments due to differing national personal data protection laws

9 out of 14 stakeholders who responded to Question 13 of the Task 2.2 targeted consultation believed that differing national data protection laws impede cross-border enforcement of toll payments.

First of all, one general problem relates to the fact that currently no EU obligation to share information exists. Therefore, some countries share information while others do not. A good example for the latter scenario is Germany. In Germany the introduction of the toll system was heavily debated due to privacy concerns related to the collection and use of such a large set of data. In order to politically enable the introduction the toll system, a very strict purpose limitation had to be introduced. This means that data that is collected for tolling purposes can exclusively be used for billing the driver and for no other reason. Consequently, Germany does not share data across borders. In most other countries, however, exchange of data collected for tolling purposes is possible (although not necessarily carried out) under the condition that the party requesting the data states why, to what end and on which grounds the applicant can (legally) ask for the information. If the service providers in a Member State do not provide information for enforcement of tolls then they become liable for the violation charge. Since in several countries laws prevent this transfer of data across borders, service providers may have to pay the fines themselves.

A closely related problem is that each country, which allows for the exchange of data has a different legal basis for charging tolls in different toll domains. This means that in some countries the toll is simply a form of tax levied by the government, in other countries it is a fee due to public body for using a road which it maintains, and in other countries it is a charge levied by a commercial road operator for access to particular stretch of road. Not paying the toll could be either a civil offence or a criminal offence according to the particular situation and so a different basis for the release of data could apply in different situations and in different toll domains.

Apart from problems in respect to different procedures determining access to data, existing enforcement regimes in EU countries have two major shortcomings in the area of cross-border enforcement, which may hinder the development of free-flow systems. These shortcomings comprise two key issues:

1. A lack of cross-border access to vehicle owner registration data enabling the identification of foreign offenders in their country of vehicle registration;
2. Even when identification is made, a lack of an appropriate enforcement process enabling the recovery of unpaid tolls, administrative charges and penalties and generally the pursuit of offenders across EU borders.

The recently adopted Directive of the Data Protection Package might facilitate cross-border cooperation on the exchange of vehicle data which might improve the current situation for toll payment infringements enforcement. However, the reform clearly expresses that data must be used just for criminal law enforcement authorities. Given the current heterogeneous legal treatment of toll payment infringements among EU Member States (e.g. France considers toll payment infringement as criminal liability while in Spain and Austria it is considered as an Administrative liability), a homogenization of the toll payment infringements' legal treatment as criminal liabilities would be required (and considered necessary by EETS providers), in order for them to be covered by the scope of the current Data Protection Regulation and its approved reform.

If new EETS legislation or more specific legislation established that the access to the different national databases was mandatory, no legal concern could block cross-border enforcement, at least as long as involved entities act according to current EU data protection legislation.

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## 2.11 Subtask 1.11: Baseline scenario

The baseline is described in detail in Section 1.2.11, whilst the detailed assumptions that feed into the baseline definition are included in Annex A. Furthermore the outputs from the baseline modelling are described above in Section 2.2. As such, this section does not contain any further description of the baseline or of its modelling outputs.

## 3 Overview of policy options

This section presents an overview of the policy options considered as part of the Impact Assessment. It provides an overview of the general policy objectives and an introduction to the various measures required to implement the three policy options considered in detail.

### 3.1 Policy option 1: Correction of regulatory failures, soft measures and self-/co-regulation

This policy option (PO1) would address the regulatory failures with legislative means (same as in PO2) while it would mobilise to the extent possible the market forces and Member States' actions to address identified market failures.

In practice, the Commission would provide a number of objectives (in line with the specific objectives in the IA) to the industry and Member States represented in the EFP and to any additional interested parties. The objectives would have to be achieved within a given time-frame (between 5 and 10 years, accounting for the time left until current contracts for the operation of tolling systems expire). The objectives would be presented in a Communication from the Commission and agreed in the form of a memorandum of understanding to be signed with industry and MS representatives. They could notably relate to:

- The agreement of harmonised interfaces and procedures on the line toll charger-EETS provider
- The prevalence of fair market rules for the toll collection in all Member States (Member States and toll chargers would commit to deal with all partners on market terms, and not to protect incumbents)
- Effective co-operation of all actors (Member States, toll chargers and EETS providers) to enforce tolls by exchanging information on offenders.

The abovementioned efforts of the partners towards the development and introduction of a self-regulation agreement would be complemented with soft measures from the European Commission, including the organisation of the co-operation (hosting of meetings, disseminating the achievements, financially supporting relevant projects, etc.).

Specific measures aimed at addressing the regulatory failures through legislative means under PO1 include:

1. No requirement anymore for EETS providers in terms of mandatory coverage, but EETS providers must make public detailed plans on extending the service to further toll domains and regularly update such plans
2. The OBU used by the EETS providers for heavy duty vehicles (HDVs) must include the three technologies; The OBU used by EETS providers for light duty vehicles (LDVs) must include DSRC (no obligation for satellite + GSM)
3. Make it possible for an EETS provider to offer EETS for HDVs only or for LDVs only

Other measures would be determined through the self-regulating process and are likely to include a weaker version of the various measures considered in PO2.

### 3.2 Policy option 2: Market correction entirely through legislation

This policy option (PO2) would attempt to resolve both the regulatory (over-regulation) and market failures (uncompetitive market practices) with legislative means. In practice, it would mean:

- Removing the provisions in the EETS Directive and Decision that are viewed as being excessive and re-establishing a technology-neutral free market
- Encouraging competition into the market with tools typically used in network industries and with a degree of administrative simplification/harmonisation

Specific measures aimed at addressing the regulatory and market failures under PO2 include:

**Regulatory failures (legislated as in PO1):**

1. No requirement anymore for EETS providers in terms of mandatory EU-wide coverage, but EETS providers must make public detailed plans on extending the service to further toll domains and regularly update such plans
2. The OBU used by the EETS providers for heavy duty vehicles (HDVs) must include the three technologies; The OBU used by EETS providers for light duty vehicles (LDVs) must include DSRC (no obligation for satellite + GSM)
3. Make it possible for an EETS provider to offer EETS for HDVs only or for LDVs only

**Market failures (also relevant to PO1, but only legislated in PO2):**

4. Member States should not make specific requirements on the ways in which the three technologies listed in the Directive are applied, which would go beyond established standards (slim vs. fat OBU, special chips, etc.) – they can only impose measurable KPIs, and would be the EETS provider's business to work out how to achieve these KPIs
5. New or renewed tolling schemes must adopt an interface for information exchange with EETS providers based on the Interoperable application profiles for information exchange between Service Provision and Toll Charging CEN/TS 16986.
6. The tolling authority must consult in advance the Commission and EETS providers on the choice of criteria for varying tolls. The Commission will issue an opinion as to the impact this choice of criteria will have on the ability of EETS providers to serve the market with existing OBUs.
7. The accreditation procedure for EETS providers, including required tests (and their cost), certificates, key performance indicators, applied standards, harmonized certification process, tolled network description, contractual terms, key performance indicators and the test plan. Any exceptions with respect to these issues must be published in the toll domain statement at least nine months before the launch of a new or renewed electronic tolling system. All the tests phase must not exceed a period of six months. The six month period does not include the trial operations in production environment. The certification process must start at least six months prior the start of operations. The same accreditation procedure must be used for all applicants.
8. The Commission will adopt by delegated act the standard format of a toll domain statement which will become mandatory for all toll chargers
9. Each toll charger must propose a test environment where the OBU manufacturer can fine tune their OBU to secure the compliance with toll domain specific requirements and obtain certification. No re-testing of such a certified OBU (except for end-to-end tests) will be required from the EETS provider using the OBU.
10. The accreditation procedure will integrate the certification of all the interoperability constituents and a suitability for use. The first phase will include all verifications of the conformity of the interoperability constituents with respect to applicable technical standards and specifications; verifications may include documentation proof, as well as laboratory and/or field tests. EETS Providers will provide the necessary declarations to demonstrate that their interoperability constituents conform with the requirements. The second phase will include all verifications allowing the correct functioning and performances of the interoperability constituents to be validated; after a system integration phase, proper pre-defined tests will be carried out in both a controlled and productive environment, including pilots with real users. The successful (or not) conclusion of each of the steps of the accreditation procedure will be certified on the basis of measurable criteria and/or parameters (such as - for example - KPIs) that will be clearly defined within the toll domain statement.
11. Member States must ensure that a co-ordinated accreditation procedure is available to EETS providers and/or OBU manufacturers for all electronic toll domains (e.g. all concessions) on their territory; in particular, it must be possible to perform laboratory tests of the equipment only once for all toll domains on the Member State's territory.
12. The contractual relationship with the EETS provider must follow the "reseller model".



13. The Commission will adopt, by delegated act, the format of a standard, electronic registration form for road users travelling within a toll domain, which must be accepted for their registration in any electronic toll domain.
14. Separation of accounts between the operator of the toll collection system and the toll service provider, when both roles are performed by the same company.
15. Provide a non-exhaustive list of services performed by EETS providers which must be remunerated by the road manager at market value (e.g. providing OBUs, payment guarantees, data transfer, role in the enforcement process, etc.).
16. If a rebate scheme is proposed by the toll charger or by the Member State, then EETS clients must have access to the same rebates and frequent-user schemes as clients of the national toll service provider.
17. EETS Providers are only required to provide the Toll Chargers with the minimum information necessary to calculate and apply the charge, namely:
  - the Vehicle's License Plate Number (including nationality);
  - the identifier of the user account
  - the identifier of the On-Board Unit
  - the applicable values of the vehicle's parameters upon which tariff is modulated

*In case of violation, the toll charger may request complementary information such as the address of the violator. In that case, the EETS provider would have to provide the requested information.*
18. EETS providers for LDVs shall be allowed by system operators, on a non-discriminatory basis, not only to provide the services related to electronic toll collection in electronic toll domains (EETS per se), but also to re-sell paper and electronic vignettes and serve their customers in congestion and environmental charging schemes (e.g. London congestion charge) and restricted access zones.
19. Provide for a mechanism for mandatory assistance by responsible authorities of the Member State where the vehicle is registered to the Member State where the toll fraud is detected. This assistance should take the form of recovery of the toll and a fine in the name of the Member State of detection of the fraud. The mechanism could be inspired by the provisions of Council Directive 2010/24/EU on mutual assistance for the recovery of claims relating to taxes, duties and other measures.
20. EETS providers must disclose upon request to system operators the identity of the presumed toll offenders who are their clients. This disclosure obligation is only valid in the framework of enforcement activities and the information on concerned EETS clients cannot be shared by the system operator with any of the EETS provider's competitors, even if one of the latter is part of the same organisational structure as the system operator.
21. As the standards are constantly evolving, the application of latest version of a standard must not be a source of discrimination for EETS providers regarding their ETC services. A toll charger request the latest version of the standard. Nevertheless, if some OBUs are already in operation in any of the MS then the toll charger must accept the OBUs compliant with a prior version of the standard even if some features or attributes are not available. The period of acceptance of prior standards is limited and fixed between the toll charger and the EETS provider taking into account the lifecycle of the OBUs in operation.
22. Provide for a mechanism for the mandatory exchange of information between Member States on the identity of vehicle owners who are proven or suspected of fraud to the toll system. The mechanism should be largely based on the provisions of Directive 2015/413/EU ("CBE") for the cross-border enforcement of road safety related offenses.

### 3.3 Policy option 3: Interoperability through strict standardisation and specific measures on cross-border

In this policy option, the Commission would request the European standardisation bodies to prepare exhaustive standards for all the interoperability constituents (on-board units, roadside infrastructure, enforcement and back-offices). The exhaustiveness of the standards means that all interoperability

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constituents would be identical from a technological point of view. The standards would then be rendered mandatory by the legislation.

The aim of the policy option would be to remove the issue of technological incompatibility from the equation. The EETS could in such a scenario become easily provided by EETS providers or toll chargers alike. Indeed, the latter could have their OBUs accepted abroad on the basis of simple commercial agreements, like it is currently the case in the cell-phone industry, for example.

The policy option will also entail an element to ensure the cross-border enforcement of tolls. It will be the same policy measure as in PO1 and PO2, namely measure number 22 from above, i.e.:

*Provide for a mechanism for the mandatory exchange of information between Member States on the identity of vehicle owners who are proven or suspected of fraud to the toll system. The mechanism should be largely based on the provisions of Directive 2015/413/EU ("CBE") for the cross-border enforcement of road safety related offenses.*

## 4 Analysis of impacts of policy options

In this section we present in detail the analysis of economic and social impacts of each policy option. It draws on the analysis of the data and information collected in Task 1, the inputs from stakeholders collected in Task 2, as well as the extensive scenario modelling carried out in Task 3.

### 4.1 Economic Impacts

#### 4.1.1 Impacts on road users

The results obtained on the economic impacts on road users are illustrated with respect to HGVs, buses and cars. According to the methodology presented in section 1.4.4, the total costs obtained in the baseline scenario are compared against the total costs estimated for each policy option.

All the policy options analysed show a positive net economic impact, but the scale of benefits varies across the policy options. In terms of overall performance, PO3 shows the highest *NPV* (i.e. € 407 million). PO2 follows (i.e. € 370 million) and PO1 generates the lowest positive impact on road users (i.e. € 117 million).

With respect to the three categories of users considered, HGVs benefit from the largest economic impact, as is expected given the greater focus of EETS on international road freight transport. In this respect, the share of the benefits increases from 80% in PO1 and PO2 to 85% in PO3. Cars have the second largest proportion of overall benefits, equal to 20% in PO1 and PO2, reducing to 14% in PO3. Finally, the impact on buses is negligible across the policy options given the small size of the modelled fleet.

The following sections present in detail the estimated economic impacts on road users for each policy option. The results are shown with respect to the three categories of road users and disaggregated by the sub-categories considered for HGVs and buses (i.e. EU and non-EU registered vehicles) and cars (i.e. commuters and non-commuters).

##### 4.1.1.1 Policy option 1: Correction of regulatory failures, soft measures and self/co-regulation

Based on the progression of EETS compatibility and interoperability in PO1 with respect to the baseline, the net flow of costs for road users improves through time. This means that the total costs of PO1 are lower than the total costs in the baseline. In particular, the benefits generated for road users increase significantly to €11m in 2020 and €34m in 2025.

The discounted cashflow for the net costs generates a *NPV* equal to €117m, as shown in Table 4-1. The category of user that benefits most significantly from the reduction in total costs is that of HGVs, with 79% of total benefits.

**Table 4-1: Flow of net costs (€/myear) to all road users for using road tolling infrastructure**

Costs by category	2016	2020	2025	Total 2016-2025
HGVs	-	8.0	28.0	120.0
Buses	-	0.2	0.4	1.8
Cars	-	2.9	5.6	29.8
<b>Total net cashflow</b>	-	<b>11.0</b>	<b>33.9</b>	<b>151.4</b>
<b>Discounted cashflow</b>	-	<b>9.4</b>	<b>23.8</b>	<b>117.4</b>

Regarding the provenance of HGVs, the outputs produced show that the large majority of vehicles are registered in EU Member States (i.e. 90%), as shown in Table 4-2. The split between costs associated to EETS and national OBUs shows that the cost for EETS OBUs increases, as the number of interoperable OBUs on the market grows according to the penetration rates assumed in the scenario,

whilst the costs of national OBUs decreases due to increased interoperability. Additional costs for HGVs are equal to €3m in 2020 and €0.4 million in 2025, respectively. As regards the national OBUs, the total costs reduce significantly, being equal to €11m in 2020 and €28m in 2025.

**Table 4-2: Flow of costs (€/m/year) to HGV users for using road tolling infrastructure**

Costs by category	2016	2020	2025	Total 2016-2025
Baseline total	196.0	186.3	179.4	1,866.7
Policy option 1 total	196.0	178.3	151.4	1,747.0
<b>Net cashflow</b>	-	<b>8.0</b>	<b>28.0</b>	<b>120.0</b>
EU	-	<b>6.9</b>	<b>25.8</b>	<b>108.3</b>
Non-EU <sup>42</sup>	-	<b>1.1</b>	<b>2.2</b>	<b>11.4</b>
Switzerland	-	<b>0.2</b>	<b>0.5</b>	<b>2.5</b>
EEA	-	<i>0.2</i>	<i>0.4</i>	<i>2.0</i>
Western Balkans	-	<i>0.1</i>	<i>0.3</i>	<i>1.2</i>
Other countries	-	<i>0.5</i>	<i>1.0</i>	<i>5.6</i>
of which EETS OBUs	-	-2.8	-0.4	-13.8
of which National OBUs	-	10.7	28.4	133.5
<b>Discounted cashflow</b>	-	<b>6.8</b>	<b>19.7</b>	<b>92.5</b>

Regarding the provenance of buses, the majority of vehicles are registered in EU Member States (i.e. 66%), as shown in Table 4-3. The total net benefits are low in absolute terms compared to HGVs and equal to c. €1.8m for the whole period 2016-2025. Most of the benefits observed derive from the reduction of costs associated with national OBUs.

**Table 4-3: Flow of costs (€/m/year) to buses for using road tolling infrastructure**

Costs by category	2016	2020	2025	Total 2016-2025
Baseline total	2.1	2.0	1.9	20.1
Policy option 1 total	2.1	1.8	1.5	18.3
<b>Net cashflow</b>	-	<b>0.2</b>	<b>0.4</b>	<b>1.8</b>
EU	-	<b>0.1</b>	<b>0.3</b>	<b>1.2</b>
Non-EU <sup>43</sup>	-	<b>0.1</b>	<b>0.1</b>	<b>0.6</b>

<sup>42</sup> Flow of costs (€/year) for non-EU countries to HGV users for using road tolling infrastructure

Costs by category	2016	2020	2025	Total
Switzerland	0	243,257	474,312	<b>2,517,593</b>
EEA	0	207,190	366,609	<b>2,032,182</b>
Western Balkans	0	117,197	251,491	<b>1,281,861</b>
Other	0	514,137	1,088,085	<b>5,577,870</b>

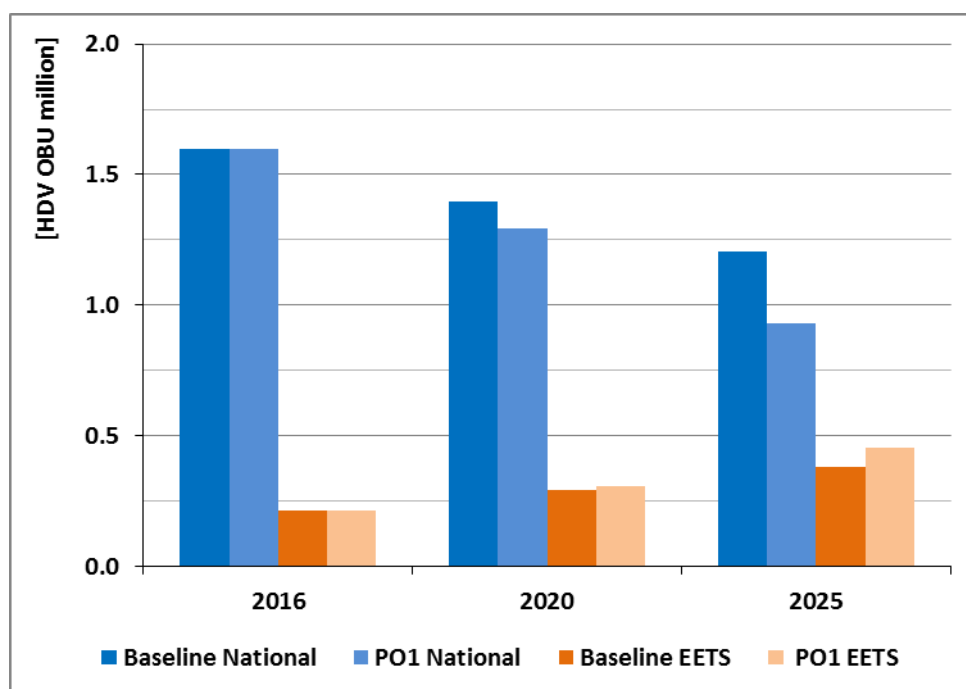
<sup>43</sup> Flow of costs (€/year) for non-EU countries to buses for using road tolling infrastructure

Costs by category	2016	2020	2025	Total
Switzerland	0	15,041	29,581	<b>156,429</b>
EEA	0	3,832	7,132	<b>38,640</b>
Western Balkans	0	34,849	63,639	<b>347,740</b>
Other	0	7,455	13,924	<b>75,319</b>

Costs by category	2016	2020	2025	Total 2016-2025
Switzerland	-	0.0	0.0	0.2
EEA	-	0.0	0.0	0.0
Western Balkans	-	0.0	0.1	0.3
Other countries	-	0.0	0.0	0.1
of which EETS OBUs	-	-0.0	0.0	-0.0
of which National OBUs	-	0.2	0.4	1.8
<b>Discounted cashflow</b>	-	<b>0.1</b>	<b>0.3</b>	<b>1.4</b>

Figure 4-1 illustrates the evolution of the number of OBUs for all HDVs (HGVs and buses) and with respect to both technology types (i.e. national vs. EETS OBUs) through time. As can be seen there is a significant increase in the total number of OBUs relative to the baseline, due to the increased extent of ETC in Europe.

Figure 4-1: Number of OBUs by type (baseline against PO1)



The total cost savings for passenger cars increase through time, from a saving of €3m in 2020 to €6m in 2025, as shown in Table 4-4. The non-commuters are the major beneficiaries, with 95% of all cost savings achieved. For both categories, users from EU Member States benefit from the largest cost reductions, specifically 69% for commuters and 70% for non-commuters.

Table 4-4: Flow of costs (€/year) for cars for using road tolling infrastructure

Costs by category	2016	2020	2025	Total 2016-2025
Baseline total	75.0	70.0	68.7	707.7
Policy option 1 total	75.0	66.8	63.2	677.9

Costs by category	2016	2020	2025	Total 2016-2025
<b>Net cashflow</b>	-	<b>2.9</b>	<b>5.6</b>	<b>29.8</b>
Total commuters	-	0.2	0.3	1.7
<i>EU</i>	-	0.1	0.2	1.2
<i>Non-EU</i>	-	0.1	0.1	0.5
Total Non-commuters	-	2.7	5.3	28.1
<i>EU</i>	-	1.9	3.7	19.8
<i>Non-EU</i>	-	0.8	1.6	8.4
<b>Discounted cashflow</b>	-	<b>2.5</b>	<b>3.9</b>	<b>23.5</b>

Note that in the impact assessment we have not attempted to assess the impacts of savings compared to the baseline related to the inclusion of congestion charging and national vignette schemes as part of EETS services aimed at passenger cars. This is because most EETS providers are focused on the business-to-business (B2B) market and they have no strategic plan to enter the business-to-customer (B2C) market segment for passenger cars<sup>44</sup>.

The B2B and B2C market segments are very different and even though the penetration rate for ETC in passenger cars increases in the modelled scenarios, the average number of tolling transactions per user decreases because the new ETC customers are mostly occasional users.

Nevertheless, EETS providers are interested in the opening of the passenger car market to EETS due to the fact that their B2B clients would like to have only one supplier for their fleet, including trucks and passenger cars. Estimating the likely market size and penetration of this offer to the B2B EETS market is however very difficult to do accurately due to a lack of data on how this is likely to evolve. It has therefore not been included in our analysis of impacts.

#### 4.1.1.2 Policy option 2: Market correction entirely through legislation

Based on the progression of EETS compatibility and interoperability in PO2 with respect to the baseline, the net flow of costs improves through time and at a faster rate compared to PO1. As in the previous case, the benefits in 2020 and 2025 increase significantly and are equal to €50m and to €82 million, respectively.

The discounted cashflow of the net costs generates a *NPV* equal to €370m, as shown in Table 4-5. Again, the category of user that benefits most significantly from the reduction of total costs is that of HGVs with 81% of total benefits.

**Table 4-5: Flow of net costs (€m/year) to all users for using road tolling infrastructure**

Costs by category	2016	2020	2025	Total 2016-2025
HGVs	-	40.9	65.3	380.0
Buses	-	0.5	0.8	4.7
Cars	-	8.3	15.4	83.5
<b>Total net cashflow</b>	-	<b>49.7</b>	<b>81.5</b>	<b>468.3</b>
<b>Discounted cashflow</b>	-	<b>42.5</b>	<b>57.3</b>	<b>370.5</b>

<sup>44</sup> The main exception in Europe is Telepass, which supplies both markets (B2C for Italy only and B2B for all of Europe). Telepass was set up to manage all of Autostrade per l'Italia's customers, around 8.5million customers, but this is a unique set-up in Europe.

As in PO1, regarding the provenance of HGVs, the large majority of vehicles are registered in EU Member States, with the share increasing to 94% in PO2, as shown in Table 4-6. The split between costs associated with EETS and national OBUs shows that the costs for EETS OBUs increases to €12m in 2020 and €16 million in 2025, whilst for national OBUs, the total costs borne by the users reduces by €53m in 2020 and €82m in 2025. This is due to a further increase in the number of EETS OBUs and a further decrease in the number of national OBUs compared to PO1.

**Table 4-6: Flow of costs (€/year) to HGVs for using road tolling infrastructure**

Costs by category	2016	2020	2025	Total 2016-2025
Baseline total	196.0	186.3	179.4	1,866.7
Policy option 2 total	196.0	145.4	114.0	1,486.7
<b>Net cashflow</b>	-	<b>40.9</b>	<b>65.3</b>	<b>380.0</b>
EU	-	<b>38.1</b>	<b>61.4</b>	<b>355.5</b>
Non-EU <sup>45</sup>	-	<b>2.8</b>	<b>4.0</b>	<b>24.5</b>
<i>Switzerland</i>	-	<i>0.6</i>	<i>0.9</i>	<i>5.3</i>
<i>EEA</i>	-	<i>0.4</i>	<i>0.6</i>	<i>3.6</i>
<i>Western Balkans</i>	-	<i>0.3</i>	<i>0.4</i>	<i>2.7</i>
<i>Other countries</i>	-	<i>1.5</i>	<i>2.1</i>	<i>12.9</i>
of which EETS OBUs	-	-12.3	-16.4	-104.4
of which National OBUs	-	53.2	81.7	484.4
<b>Discounted cashflow</b>	-	<b>35.0</b>	<b>45.9</b>	<b>300.9</b>

Regarding the provenance of buses, the share of vehicles registered in EU Member States increases relative to PO1 to 73%, as shown in Table 4-7. Again, total net benefits are low in absolute terms compared to HGVs and equal to approximately €5m for the whole period 2016-2025. Most of the benefits observed derive from the reduction of costs associated with reduced numbers of national OBUs.

**Table 4-7: Flow of costs (€/year) to buses for using road tolling infrastructure**

Costs by category	2016	2020	2025	Total 2016-2025
Baseline total	2.1	2.0	1.9	20.1
Policy option 2 total	2.1	1.5	1.1	15.4
<b>Net cashflow</b>	-	<b>0.5</b>	<b>0.8</b>	<b>4.7</b>
EU	-	<b>0.4</b>	<b>0.6</b>	<b>3.4</b>

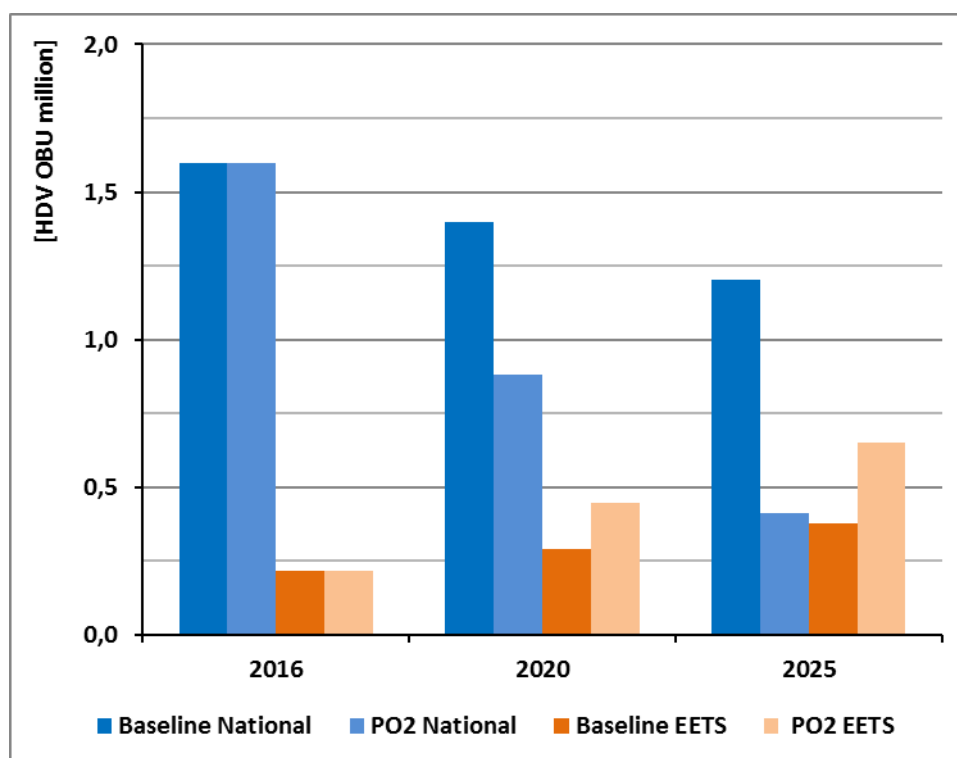
<sup>45</sup> Flow of costs (€/year) for non-EU countries to HGVs for using road tolling infrastructure

Costs by category	2016	2020	2025	Total
Switzerland	0	588,198	879,510	5,285,422
EEA	0	422,703	570,763	3,614,453
Western Balkans	0	308,148	439,945	2,706,501
Other	0	1,482,102	2,087,511	12,931,991

Costs by category	2016	2020	2025	Total 2016-2025
Non-EU <sup>46</sup>	-	0.1	0.2	1.3
<i>Switzerland</i>	-	0.0	0.1	0.4
<i>EEA</i>	-	0.0	0.0	0.1
<i>Western Balkans</i>	-	0.1	0.1	0.7
<i>Other countries</i>	-	0.0	0.0	0.2
of which EETS OBUs	-	-0.1	-0.2	-1.0
of which National OBUs	-	0.6	0.9	5.7
<b>Discounted cashflow</b>	-	<b>0.4</b>	<b>0.6</b>	<b>3.7</b>

Figure 4-2 illustrates the evolution of the number of OBUs for all HDVs (HGVs and buses) and with respect to both technology types (i.e. national vs. EETS OBUs) through time. As can be seen there is a further increase in the number of EETS OBUs compared to PO1, whilst the number of national OBUs decreases significantly, due to the increased EETS compatibility in PO2.

Figure 4-2: Number of OBUs by type (baseline against PO2)



The total cost savings for passenger cars increase through time, from a saving of €8m in 2020 to €15m in 2025, as shown in Table 4-8. Non-commuters are the major beneficiaries, with 95% of all cost savings

<sup>46</sup> Flow of costs (€/year) for non-EU countries to buses for using road tolling infrastructure

Costs by category	2016	2020	2025	Total
Switzerland	0	39,593	61,146	361,608
EEA	0	7,923	10,410	66,885
Western Balkans	0	80,566	110,581	694,290
Other	0	17,793	25,098	155,362



achieved. For both categories, the users of EU Member States benefit from the largest costs reduction, specifically 76% for commuters and 78% for non-commuters.

**Table 4-8: Flow of costs (€m/year) to cars for using road tolling infrastructure**

Costs by category	2016	2020	2025	Total 2016-2025
Baseline total	75.0	69.8	68.7	707.7
Policy option 2 total	75.0	61.5	53.3	624.2
<b>Net cashflow</b>	-	<b>8.3</b>	<b>15.4</b>	<b>83.5</b>
Total commuters	-	0.4	0.7	4.0
<i>EU</i>	-	0.3	0.6	3.1
<i>Non-EU</i>	-	0.1	0.2	0.9
Total Non-commuters	-	7.9	14.7	79.5
<i>EU</i>	-	6.0	11.7	62.3
<i>Non-EU</i>	-	1.8	3.0	17.2
<b>Discounted cashflow</b>	-	<b>7.1</b>	<b>10.8</b>	<b>65.8</b>

#### 4.1.1.3 Policy option 3: Interoperability through strict standardisation and specific measures on cross-border enforcement of tolls

Based on the progression of EETS compatibility and interoperability in PO3 with respect to the baseline, the net flow of costs improves through time, again at a faster rate compared to PO1 and PO2. The benefits in 2020 and 2025 increase and are equal to €50m and to €98 million, respectively.

The discounted cashflow of the net costs generates a *NPV* equal to €408m, as shown in Table 4-9. Again, the category of user that benefits most significantly from the reduction of total costs is that of HGVs with 85% of total benefits.

**Table 4-9: Flow of net costs (€m/year) to all users for using road tolling infrastructure**

Costs by category	2016	2020	2025	Total 2016-2025
HGVs	-	40.9	86.2	442.5
Buses	-	0.5	1.0	5.3
Cars	-	8.3	11.1	70.6
<b>Total net cashflow</b>	-	<b>49.7</b>	<b>98.3</b>	<b>518.4</b>
<b>Discounted cashflow</b>	-	<b>42.5</b>	<b>69.0</b>	<b>407.7</b>

As in PO1 and PO2, regarding the provenance of HGVs, the large majority of vehicles are registered in EU Member States, with the share remaining at 94% as in PO2, as shown in Table 4-10. The split between costs associated with EETS and national OBUs shows that the costs for EETS OBUs increases to €12m in 2020 and €9 million in 2025 (reduced from the €16m in 2025 in PO2 due to the lower costs of individual EETS OBU units caused by lower EETS provider fees), whilst for national OBUs, the total costs borne by the users reduces by €53m in 2020 and €95m in 2025, due to a further reduction in the number of national OBUs in PO3.

**Table 4-10: Flow of costs (€m/year) to HGVs for using road tolling infrastructure**

Costs by category	2016	2020	2025	Total 2016-2025
Baseline total	196.0	186.4	179.4	1,866.7
Policy option 3 total	196.0	145.4	93.2	1,424.2
<b>Net cashflow</b>	-	<b>40.9</b>	<b>86.2</b>	<b>442.5</b>
EU	-	<b>38.1</b>	<b>81.7</b>	<b>416.5</b>
Non-EU <sup>47</sup>	-	<b>2.8</b>	<b>4.5</b>	<b>26.0</b>
<i>Switzerland</i>	-	0.6	1.0	5.6
<i>EEA</i>	-	0.4	0.6	3.8
<i>Western Balkans</i>	-	0.3	0.5	2.9
<i>Other countries</i>	-	1.5	2.4	13.8
of which EETS OBUs	-	-12.3	-8.6	-81.2
of which National OBUs	-	53.2	94.8	523.7
<b>Discounted cashflow</b>	-	<b>35.0</b>	<b>60.5</b>	<b>347.3</b>

Regarding the provenance of buses, the share of vehicles registered in EU Member States increases marginally relative to PO2 to 74%, as shown in Table 4-11. Again, total net benefits are low in absolute terms compared to HGVs and equal to approximately €5m for the whole period 2016-2025. Most of the benefits observed derive from the reduction of costs associated with a reduced number of national OBUs.

**Table 4-11: Flow of costs (€m/year) to buses for using road tolling infrastructure**

Costs by category	2016	2020	2025	Total 2016-2025
Baseline total	2.1	2.0	1.9	20.1
Policy option 3 total	2.1	1.5	0.9	14.8
<b>Net cashflow</b>	-	<b>0.5</b>	<b>1.0</b>	<b>5.3</b>
EU	-	<b>0.4</b>	<b>0.8</b>	<b>3.9</b>
Non-EU <sup>48</sup>	-	<b>0.1</b>	<b>0.2</b>	<b>1.4</b>
<i>Switzerland</i>	-	0.0	0.1	0.4
<i>EEA</i>	-	0.0	0.0	0.1

<sup>47</sup> Flow of costs (€m/year) for non-EU countries to HGVs for using road tolling infrastructure

Costs by category	2016	2020	2025	Total
Switzerland	0	588,198	969,727	5,556,075
EEA	0	422,703	625,512	3,778,700
Western Balkans	0	308,148	499,597	2,885,457
Other	0	1,482,102	2,369,847	13,779,001

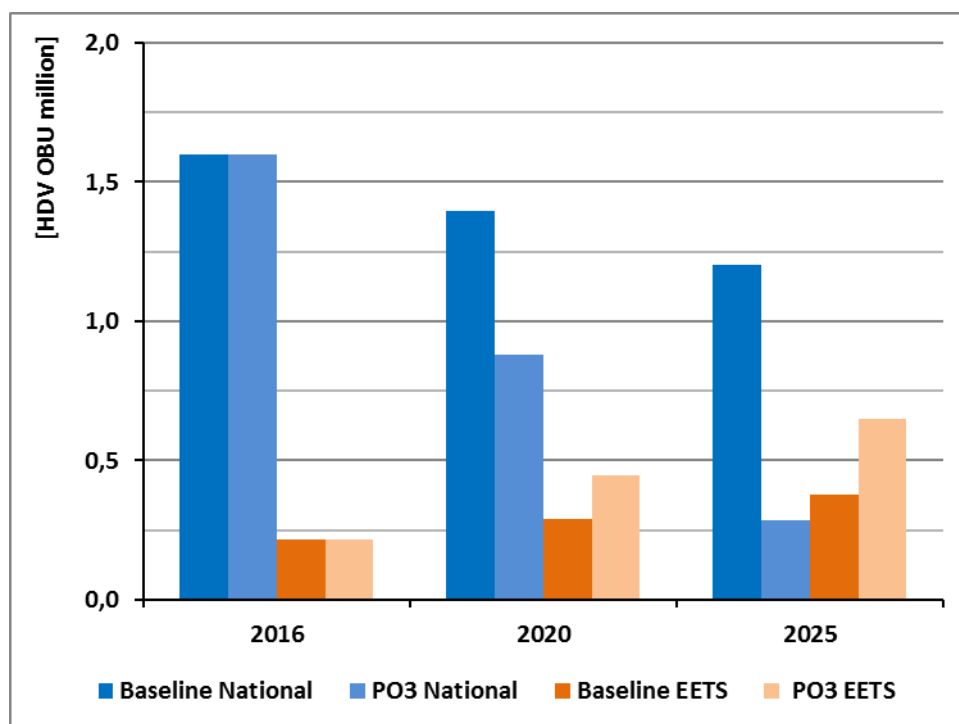
<sup>48</sup> Flow of costs (€m/year) for non-EU countries to buses for using road tolling infrastructure

Costs by category	2016	2020	2025	Total
Switzerland	0	39,593	70,435	389,475
EEA	0	7,923	11,327	69,636
Western Balkans	0	80,566	123,832	734,044
Other	0	17,793	28,248	164,812

Costs by category	2016	2020	2025	Total 2016-2025
<i>Western Balkans</i>	-	0.1	0.1	0.7
<i>Other countries</i>	-	0.0	0.0	0.2
of which EETS OBU	-	-0.1	-0.1	-0.8
of which National OBU	-	0.6	1.0	6.1
<b>Discounted cashflow</b>	-	<b>0.4</b>	<b>0.7</b>	<b>4.2</b>

Figure 4-3 illustrates the evolution of the number of OBUs for all HDVs (HGVs and buses) and with respect to both technology types (i.e. national vs. EETS OBUs) through time. As can be seen the number of EETS OBUs is the same as in PO2 (because the overall coverage of EETS remains the same), whilst the number of national OBUs decreases significantly (due to the increased EETS interoperability in PO3 compared to PO2). Note that there remains some national OBUs in 2025 even in PO3. This can be explained by the current high penetration rate of national OBUs in some countries (e.g. Belgium is 90% national OBU and 10% EETS OBU). The expectation is that there will remain a percentage of national OBUs in circulation in 2025. However, under PO3, a national OBU can also be used in other countries.

Figure 4-3: Number of OBUs by type (baseline against PO3)



The total cost savings for passenger cars increase through time, from a saving of €8m in 2020 to €11m in 2025<sup>49</sup>, as shown in Table 4-12.

<sup>49</sup> Note that the benefits related to cars are higher in PO2 than PO3 in 2025 (i.e. €15m vs. €11m). This result is due to the simplified approach used to structure the model for cars, whereby the costs of OBUs for cars are assumed the same as for HDVs, with the cost of EETS OBUs decreasing significantly between PO2 and PO3. However, the overall result is not affected, as HDVs benefit from the majority of the estimated savings and the final ranking of the policy options is unchanged.

**Table 4-12: Flow of costs (€m/year) to cars for using road tolling infrastructure**

Costs by category	2016	2020	2025	Total 2016-2025
Baseline total	75.0	69.8	68.7	707.7
Policy option 3 total	75.0	61.5	57.7	637.1
<b>Net cashflow</b>	-	<b>8.3</b>	<b>11.1</b>	<b>70.6</b>
Total commuters	-	0.4	-0.6	-0.1
<i>EU</i>	-	0.3	-0.8	-1.1
<i>Non-EU</i>	-	0.1	0.2	1.0
Total Non-commuters	-	7.9	11.7	70.6
<i>EU</i>	-	6.0	8.4	52.4
<i>Non-EU</i>	-	1.8	3.3	18.3
<b>Discounted cashflow</b>	-	<b>7.1</b>	<b>7.8</b>	<b>56.2</b>

#### 4.1.2 Impacts on toll chargers

The three policy options offer different approaches to achieving greater interoperability of ETC in the EU, creating the conditions to allow a quicker and sustainable expansion of EETS providers into new markets. All these approaches involve an evolution of the toll chargers' status quo, modifying their relationship with EETS providers but also adapting some of their procedures and infrastructure. The following three sub-sections describe how the different policy options will impact the Toll Chargers.

##### 4.1.2.1 Policy option 1: Correction of regulatory failures, soft measures and self-/co-regulation

PO1 and PO2 are based on a series of specific measures which mostly involve toll chargers. The following screening of impacts provides an analysis of the way these measures (or groups of measures) will influence toll chargers in practical terms and, where possible, an evaluation of the costs implied.

##### 4.1.2.1.1 Qualitative assessment of policy option measures

A number of measures are targeted at restricting the range of technologies and interfaces which can be used, to help support greater technical interoperability of measures. The impacts of these measures on toll chargers can be summarised as follows:

- The measure preventing Member States from formulating specific requirements on the way the three technologies listed in the Directive are applied beyond established standards (measure number 4) will change the procedure for toll chargers and/or a Member States introducing new ETC systems or upgrading existing ones. Functional and technical requirements will be limited to those specified by the applicable technical and operational standards, as defined and referenced by the EETS legal framework.

As a consequence toll chargers will be limited in terms of functional and technical requirements as well as the business rules specified for the design, development, implementation and operation of a new scheme. They will still be capable of defining specific business rules and requirements to be valid for the local electronic toll collection service (offered to local users) but they will have to ensure that their system supports the EETS service along the terms defined by the applicable technical standards.

- Toll chargers introducing or developing an electronic toll collection system will be obliged to integrate within their back-office architecture an interface compatible with the back-offices of EETS providers (measure number 5) in conformance with the CEN TS 16986 standard (application profile for the ISO 12855 standard). This implies the need to adapt existing business processes as well as back-office infrastructure.

For toll chargers introducing new charging systems, the implementation of an interface in compliance with the CEN TS 16986 standard would basically come at no cost. However the situation is different for those toll chargers who are already operating a system and that are

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currently using back-office systems and interfaces based on proprietary specifications. The adaptation of these systems might come at a cost of €1-5m, depending on the complexity of the system. Toll chargers may continue to support the existing proprietary interfaces as long as a CEN TS 16986 compatible interface is supported.

- The measure providing additional flexibility to EETS providers by making toll chargers accept OBUs compliant with a prior version of a standard even if some features or attributes are not available (measure number 21), takes into account the fact that the market will continue to evolve in terms of technologies, functionality and performance and that standardisation processes will follow these trends by updating the standardisation framework. Both toll chargers and EETS providers will be faced with such technological evolution and with the need to maintain their own facilities in line with existing technologies and standards. Under the assumption that technical standards will be upgraded along with a mechanism that ensures coherence across the whole system (by adopting a form of release management and system configuration mechanism), toll chargers will be forced to implement new developments (in order to maintain compatibility with upcoming standards) as well as to maintain a backward compatibility (in order to ensure the possibility of handling the existing OBUs for a certain period of time). This may add significantly to the complexity of their operations.

A series of measures are aimed at improving the accreditation procedures for new EETS providers. While these address a key aspect of the relationship between the latter and the toll chargers, they have a knock-on effect of introducing some constraints for toll chargers:

- The flexibility of toll chargers as well as of relevant Member States in the use of specific criteria upon which to calculate tolls due (e.g. vehicle parameters such as weight, axles, etc.), will be limited by the obligation for them to consult in advance with the Commission and EETS providers on the choice of criteria used (measure number 6). When planning the implementation of a new charging scheme rather than the evolution of an existing one, toll chargers will have to define system requirements within the framework of the applicable technical standards, in order to maintain compatibility with the existing base of circulating OBUs.
- When planning for the introduction of a new charging scheme, toll chargers will be required to put significant resources into setting up EETS accreditation procedures (measure number 7). The development of such a procedure, including setting up of the technical, contractual and operational framework within which EETS providers will operate, will have to be considered as a key milestone of a deployment project, and taken into account from the early stages of project planning.
- According to the measure introducing a standard format for toll domain statements, all toll chargers will be required to develop, publish and maintain a Toll Domain Statement based on a standardised structure for all toll domains (measure number 8). This will not constitute a significant issue for the toll chargers, but will require them to publish a minimum set of information and to arrange it along a standardised framework.
- The measure obliging toll chargers to propose a test environment where the OBU manufacturer can fine tune their OBU (measure number 9) implies an investment from each toll charger, (rather than from a group of toll chargers in case of an interoperable nationwide scheme) for the establishment and the operation and maintenance of such a test environment.

This could involve a substantial investment given that different types of roadside equipment (both single lane and free-flow) with the same configuration as for real equipment must be made available to perform pre-certification tests, so that the behaviour of the OBU – as measured in this environment – is the same as can be expected in a real operating environment. Toll chargers will need to identify an appropriate location and invest for the procurement, installation and management of this test equipment.

- Another measure also implies that all toll chargers must define a harmonised procedure for the certification of the interoperability constituents as well as for the verification of their suitability for use (measure number 10). The end-to-end procedure must be defined according to clear guidelines: not only will the different steps of the certification and suitability for use phases have to be adapted, but the rules upon which the successful completion of each certification phase will also have to be clearly defined, in order to ensure objective evaluations.

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Furthermore, all toll chargers will have to define a detailed certification procedure for the OBUs to be accepted on their toll domain and allow this procedure to be implemented by laboratories throughout Europe. Member States as well as toll chargers will have to recognise the role of such laboratories and the outcome of the testing and verification performed.

Other measures which are aimed more at the business model and administrative aspects of EETS are also likely to impact toll chargers, as follows:

- The measure defining the contractual relationship with the EETS provider as strictly following the "Reseller model" (measure number 12) is likely to be welcomed by both the toll chargers and service providers. In particular the operation of the toll chargers will be simplified by adopting the Reseller model, from both an accounting and a tax perspective:
  - In terms of accounting, the number of invoices to be produced by the toll charger for the toll transactions will dramatically decrease (only one invoice per reseller) and this will strongly facilitate the work of the toll charger.
  - From a tax perspective, the Reseller model is much simpler and widely accepted by the national tax authorities throughout Europe, as the roles are much better defined and no ambiguity can exist with regards to the services provided by the toll charger or the service provider, in terms of the applicability for VAT.

Finally, the Reseller model is currently used by a large portion of active service providers (such as for example fuel and fleet card issuers) and therefore is the model with which toll chargers are most used to dealing with.

- User registration has been – over the last few years – a challenging topic in the context of implementing and operating ETC systems across Europe. Member States and toll chargers have often defined different registration requirements, in particular with regards to the registration process as well as to the documentation to be collected and maintained. The setting-up of a harmonised registration process for road users, based on an electronic registration form (measure number 13), will force toll chargers to implement a harmonised registration process and to standardise the types of information collected.
- Toll Chargers will be obliged to clearly separate the activities of toll charging from the activities of toll service provision, for both local and EETS services, whilst separate toll service providers will be introduced into the value chain (measure number 14).
- In several Member States rebate schemes are available for HGVs, with haulage companies being allowed to obtain a rebate as a function of the amount of tolls paid by its vehicles over a 12 months period, the characteristics of its vehicles (namely their environmental characteristics) and of the yearly budget made available by the Member State. The implementation of a measure ensuring that if a rebate scheme is proposed by the toll charger, then EETS clients must have access to the same rebates as clients of the national toll service provider (measure number 16), will force toll chargers to adapt their rebate handling procedure and tools in order to open them to EETS providers.
- One measure foresees that EETS providers should only be required to provide the toll chargers with the minimum information necessary to calculate and apply the charge (measure number 17). Toll chargers and corresponding Member States will have to adapt their business processes in recognition of the fact that EETS providers, as representatives of road users, are only required to provide a limited set of information. In particular toll chargers and Member States will have to accept that EETS providers manage the relationship with road users and collect/maintain the necessary information on road users, providing them only a limited set of information that corresponds to the information necessary to correctly apply the charges for their tolling system. This rule will have to be adopted even in those cases where Member States are planning the implementation of a tax charging scheme, where it is usually assumed that a direct link between the road user and the taxation authority is kept.

Three measures from PO1 and PO2 are aimed at addressing the problem of toll evasion and at improving cooperation between Member States on toll recovery:

- Toll chargers, especially those managing free-flow charging schemes for both heavy goods and light vehicles, are often faced with the problem of enforcing violations performed by occasional users, in particular for international traffic. Whenever they detect an occasional (i.e. non-registered) user using their toll domain without having paid the necessary toll, they can collect

evidence of the toll evasion but generally have difficulties in obtaining information about the owner of the vehicle required to enforce it outside of their domain and national territory.

The provision for the mandatory exchange of information between Member States on the identity of vehicle owners (measure number 22) would allow toll chargers to search and obtain more reliable information about the owner of a specific vehicle that has been detected in violation of a charging scheme. This would provide the possibility of establishing a procedure for the recovery of the toll due as well as of any additional administrative fees. This measure presents a significant step forward in supporting toll chargers to recover unpaid tolls.

- Toll chargers also face non-payment of tolls by vehicle users that are registered with one or more toll service providers in Europe. The possibility of accessing data on vehicle owners through toll service providers (including EETS providers) represents another opportunity to identify vehicles that have not paid tolls and are liable for an enforcement procedure for the recovery of any tolls due and any additional administrative fees. This measure (measure number 20) would go hand in hand with that described above in improving the ability of toll chargers to recover unpaid tolls.
- Enforcement procedures launched by a Toll Charger on the basis of the information obtained on the ownership of a violating vehicle would allow a Toll Charger to contact a vehicle's owner and initiate (voluntary) debt recovery procedures. However this procedure does not ensure 100% reliability as long as the vehicle owners are aware that toll chargers cannot enforce them outside of their national territory. The provision (in addition to the previously mentioned measures) of a mechanism allowing toll chargers to obtain the support of other Member States to enforce debt recovery (measure number 19) would significantly boost the ability of toll chargers to recover tolls by increasing the effectiveness of enforcement-related actions.

Together, these three measures will provide toll chargers with a set of powerful tools to control and manage toll evasion, ultimately resulting in increased revenues and reductions in the levels of evasion.

#### 4.1.2.1.2 Quantified impacts

Not all the measures described above have a direct economic impact for toll chargers. We have estimated the economic impacts for toll chargers based on the impacts of the following most relevant effects from the various measures included in PO1:

- Additional investment costs:
  - Additional investment for updating back-office interfaces to comply with the CEN TS 16986 standard: €2.5m per back-office, with an assumption of 25 back-offices to be updated. On top of this, in the self-regulation context of PO1, toll chargers updating their interfaces will most likely be obliged to either adapt their systems to make interoperability possible with EETS providers that are not compliant with the standard or even to finance the updates for these EETS providers to make them compliant.  
We expect that a number of toll chargers will make this investment, in order to comply with the standard even if they are not obliged to do so by the legislation. Indeed, they have an interest in becoming compliant with the standard as it will have a positive impact for them in terms of automation of procedures and of general operational efficiency. As such, on the way to interoperability, even in a self-regulatory context, it is reasonable to expect that many toll chargers will become compliant, as it provides clear benefits with a low level of complexity for implementation and limited costs.
  - Additional investments for the set-up (at national rather than at local level) of a test environment where different manufacturers may perform pre-compliance verifications with their OBUs: 20 test environments to be set-up, each of them estimated at €100,000;
  - In total, taking into account hidden costs such as suppliers' margin and risk management, we estimate the additional costs compared to the baseline at around €300m over the period to 2025.
- Increase of toll revenues because of the overall reduction of the toll violation rate due to the various measures aimed at improved cross-border cooperation.

Furthermore, we can anticipate potential savings by 2025 for toll chargers due to the decreasing fleet of national OBUs which they will need to manage. These savings stem from reduced expenses directly linked to the management of the OBU fleet, as follows:

- We have considered as CAPEX a renewal of the OBU fleet once by 2025 (lifecycle of 7 years). For the sake of the aggregated calculation we assumed that the European fleet will be renewed in 2021, so we take as basis the number of OBUs in 2021, on which we apply a 20% uplifts which consists of a safety margin (as toll chargers needs to plan for potential defects, so they need to procure more OBUs than the number in use);
- We estimate two cost items in terms of OPEX: telecom costs (only for GNSS) and OBU maintenance costs.

In PO1, the estimated savings over the period to 2025 are around €12m.

#### 4.1.2.2 Policy option 2: Market correction entirely through legislation

##### 4.1.2.2.1 Qualitative assessment of policy option measures

As the measures to be implemented are exactly the same as for PO1, the mechanisms for impacts described on a measure-by-measure basis in the previous section remain basically the same. However, for PO2, measures will be enforced by means of legislative acts and therefore we expect that changes will be more widely implemented by toll chargers and other stakeholders. As a result, whilst the fundamental effects of these measures will be the same as for PO1, their effectiveness will be higher.

##### 4.1.2.2.2 Quantified impacts

We have estimated economic impacts for toll chargers based on the impacts of the following most relevant effects from the various measures included in PO2:

- Additional investment costs:
  - Additional investment for updating back-office interfaces to comply with the CEN TS 16986 standard: €2.5m per back-office, with an assumption of 35 back-offices to be updated;
  - Additional investments for the set-up (at national rather than at local level) of a test environment where different manufacturers may perform pre-compliance verifications with their OBUs: 20 test environments to be set-up, each of them estimated at €100,000;
  - In total, taking into account hidden costs such as suppliers' margin and risk management, we estimate the additional costs compared to the baseline at around €200m over the period to 2025.
- Increase of toll revenues because of the overall reduction in toll evasion rates due to the various measures aimed at improved cross-border cooperation.

In PO2, the estimated savings by 2025 due to the decreasing fleet of national OBUs are around €48m, using the same method described in P01 above.

In addition, an increase of toll revenues is anticipated due to measures to improve the effectiveness of cross-border toll recovery, corresponding to about 1% of the overall aggregated EU-level toll revenues, which could amount to around €300m per year by 2025<sup>50</sup>. Note that this high-level estimate is provided for information purposes only and is not included in the overall economic impacts summary in Section 4.1.4.

#### 4.1.2.3 Policy option 3: Interoperability through strict standardisation and specific measures on cross-border enforcement of tolls

##### 4.1.2.3.1 Qualitative assessment of policy option measures

In PO3, the Commission would request the European standardisation bodies to prepare exhaustive standards for all the interoperability constituents (on-board units, roadside infrastructure, enforcement and back-offices). The exhaustiveness of the standards means that all interoperability constituents

<sup>50</sup> Based on the figures on toll revenues by countries available in the Support Study for the Impact Assessment Accompanying the Revision of Eurovignette Directive 1999/62/EC (Ricardo, 2017) and on the ASECAP website.



would be identical from a technological point of view. The standards would then be rendered mandatory by the legislation.

The aim of the policy option would be to remove the issue of technological incompatibility from the equation. EETS could in such a scenario be easily provided by EETS providers or toll chargers alike. Indeed, the latter could have their OBUs accepted across multiple markets on the basis of simple commercial agreements, as is currently the case in the mobile phone industry, for example.

As far as the impacts of this option on the toll chargers are concerned, it is clear that they will be forced to procure and/or amend their system infrastructure in order to fully comply with the policy option. Whereas today toll chargers may make use of slightly different system architectures and profiles, without affecting technical interoperability, they would be obliged to migrate towards a single harmonised system architecture and application profile, with the road users equipped with a standardised type of OBU and the entire tolling system operating on the basis of strictly standardised interfaces.

In principle all toll chargers will be faced with the need to invest in migrating their own systems (both roadside and central system infrastructure), the extent of such additional investments depending on how much the current infrastructure diverges from the targeted specification.

Whilst technical interoperability will be ensured by means of strict standardisation, the effectiveness of the process will also be increased by implementing a specific measure on cross-border enforcement of tolls (measure number 19), similar to that defined by the equivalent measure in PO2. Thanks to this measure, toll chargers will have the possibility of significantly increasing the effectiveness of enforcement processes, in particular with regards to international road users.

#### 4.1.2.3.2 Quantified impacts

As far as economic impacts are concerned, toll chargers (as well as toll service providers) will be required to upgrade their infrastructure, namely the roadside infrastructure (for tolling and enforcement) and the back-office infrastructure, in order to comply with the legislated technical standards. These upgrades are likely to affect all toll chargers to varying degrees.

Through using the model developed for Task 1.3, we have estimated the implementation costs for the various infrastructure upgrades required in PO3, as shown in Table 4-13. The key assumptions used, based on expert estimates, are as follows:

- All equipment on ETC lanes would need to be modified, at a unit cost estimated at c. €30k;
- All tolling stations based on DSRC free-flow would need to be modified, at a unit cost estimated at c. €100k;
- All enforcement stations of GNSS free-flow would need to be modified, at a unit cost estimated at c. €300k;
- The majority of the back office systems would need to be updated, at a unit cost estimated at c. €2.5m.

The total cumulative cost to toll chargers for PO3 is estimated at around €1 billion over the period to 2025. Note that in PO3, there is no additional cost associated with setting up a test environment for OBU testing in each toll domain (as in PO1 and PO2), since by definition all OBUs will be compatible based on the strict standardisation enforced.

**Table 4-13: Evaluation of investment costs for toll chargers in PO3**

Cost Element	Qty.	Unit Cost (k EUR)	Total Cost (million EUR)
<b>ETC Lanes</b>	<b>25,000</b>	<b>30</b>	<b>750</b>
<b>Free-Flow Tolling Stations</b>	<b>1,100</b>	<b>100</b>	<b>110</b>
Austria	400	100	40
Czech Republic	300	100	30
Poland	300	100	30

Cost Element	Qty.	Unit Cost (k EUR)	Total Cost (million EUR)
Slovenia	100	100	10
<b>Free-Flow Enforcement Stations</b>	<b>460</b>	<b>300</b>	<b>138</b>
Germany	300	300	90
Belgium	40	300	12
Slovak Republic	70	300	21
Hungary	50	300	15
<b>Back-Office Systems</b>	<b>40</b>	<b>2,500</b>	<b>100</b>
<b>TOTAL</b>			<b>1,098</b>

In addition, an increase of toll revenues is anticipated (as for with the previous policy options) with respect to the measures that will be implemented to provide toll chargers with improved means to recover tolls from toll evaders. Additional revenues of around 1% of overall aggregated EU-level toll revenues are estimated, which could amount to around €300m per year by 2025<sup>51</sup>. Note that this high-level estimate is provided for information purposes only and is not included in the overall economic impacts summary in Section 4.1.4.

In PO3, the estimated savings by 2025 due to the decreasing fleet of national OBUs are around €51m, using the same method as in P01 and P02.

### 4.1.3 Impacts on EETS providers

The economic impacts of the policy options for EETS providers are mainly focused around two topics:

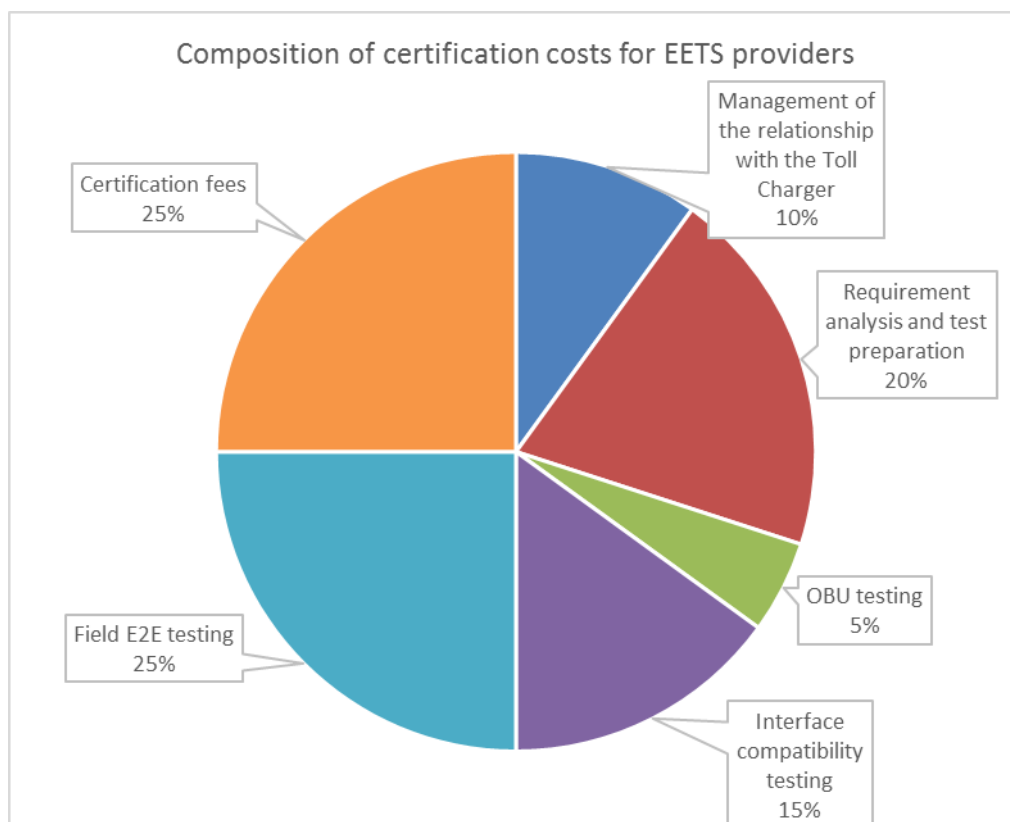
- The simplification of the accreditation procedure allowing an EETS provider to operate in a given toll domain;
- The clarification of fair remuneration of EETS providers by toll chargers for the service they provide.

The first aspect, i.e. simplification of the accreditation procedure, is a key step in the expansion of the operating network of EETS providers in the European market, and is driven by a series of measures within PO1 and PO2. These measures are focused on supporting the harmonisation of accreditation practices in the different Member States, an initiative that is reinforced in the case of the broadly standardised technological environment stemming from PO3.

The cost of accreditation for an EETS provider in a new toll domain in the baseline is typically broken down as illustrated in Figure 4-4 below.

<sup>51</sup> Based on the figures on toll revenues by countries available in the Support Study for the Impact Assessment Accompanying the Revision of Eurovignette Directive 1999/62/EC (Ricardo, 2017) and on the ASECAP website.

**Figure 4-4: Estimated composition of the certification costs for EETS providers<sup>52</sup>**

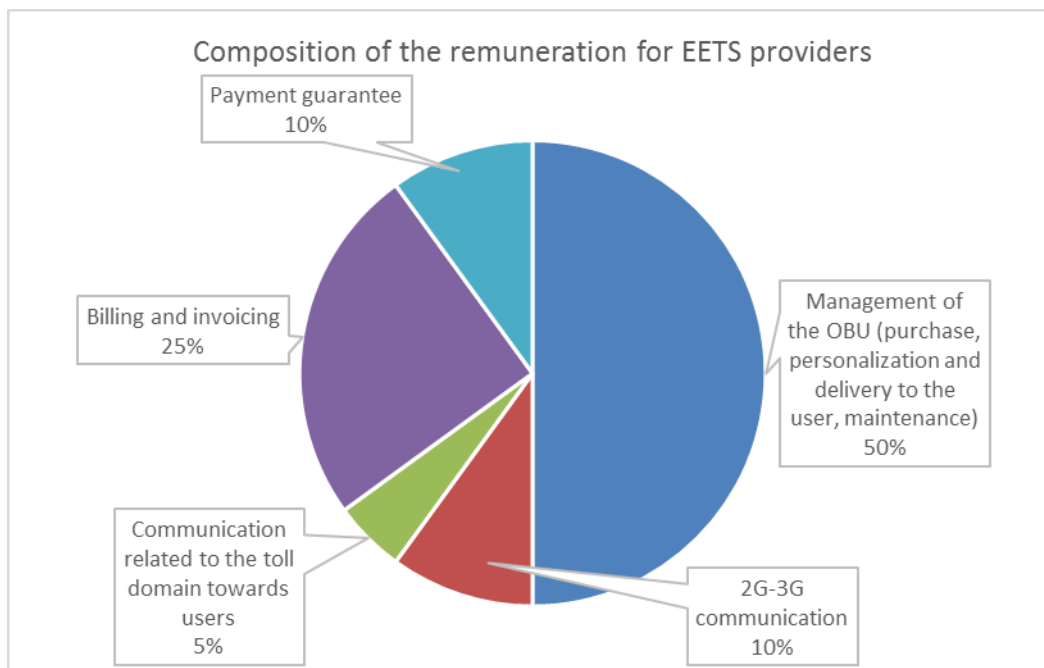


The second aspect, i.e. fair remuneration of EETS providers, has a clear impact on their business case for entering new markets. PO1 and PO2 foresee the provision by the Commission of a non-exhaustive list of services performed by EETS providers which must be remunerated by the road manager at market value<sup>53</sup> (measure number 15). This measure directly addresses the question of fair remuneration, and we can assume that the extent of the application of this measure will be much lower in the case of self-regulation (PO1) than in a legislation-based approach (PO2). The scope of services we can reasonably assume should be covered by the remuneration of EETS providers is illustrated in Figure 4-5 for GNSS toll domains and Figure 4-6 for DSRC toll domains.

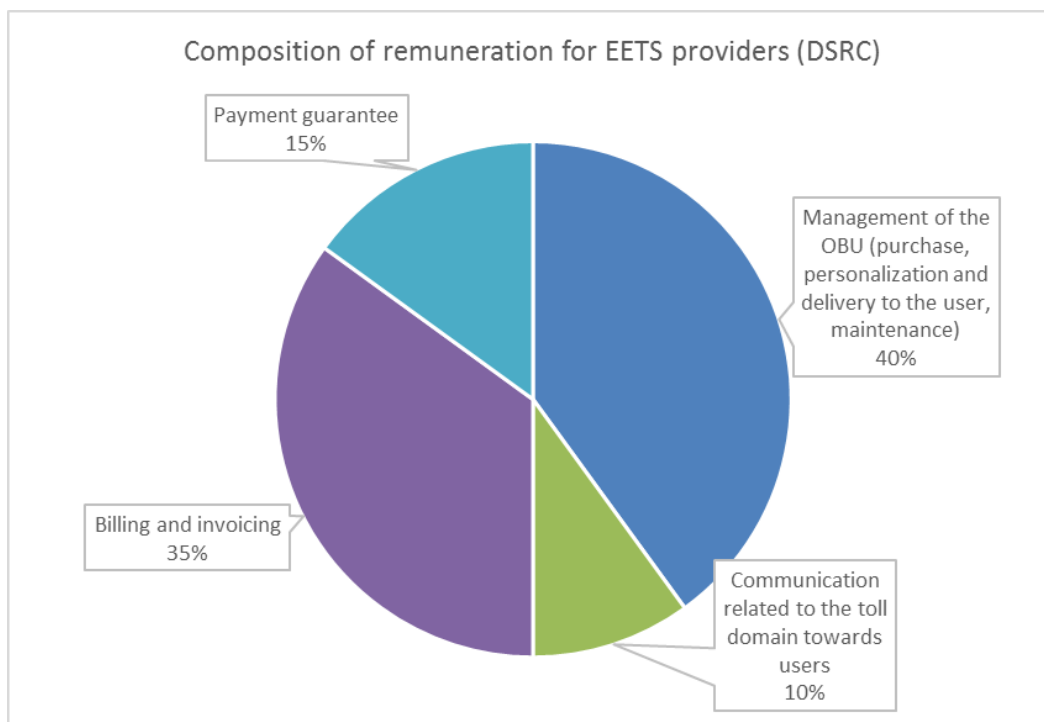
<sup>52</sup> Estimation based on interviews with toll chargers and expert knowledge

<sup>53</sup> It should be noted however that, at an aggregated level of the entire European tolling ecosystem, impacts on toll chargers stemming from the increase in remuneration of EETS providers actually offset the impacts on EETS providers, and thus no overall cost impact is foreseen based on this measure being implemented.

**Figure 4-5 Estimated composition of the remuneration costs for EETS providers in GNSS toll domains<sup>54</sup>**



**Figure 4-6: Estimated composition of the remuneration costs for EETS providers in DSRC toll domains**



**4.1.3.1 Policy option 1: Correction of regulatory failures, soft measures and self-/co-regulation**

**4.1.3.1.1 Accreditation procedure**

In PO1 and PO2, a number of measures are likely to have an impact on the cost borne by EETS providers for accreditation in different toll domains:

- The standardisation of the information exchange interface between EETS providers and toll chargers for new or renewed tolling schemes (measure number 5) would ease the accreditation

<sup>54</sup> Estimation based on interviews with toll chargers and expert knowledge

process in terms of interface compatibility tests. Indeed, one of the critical technical areas to be tested during an accreditation procedure is the compatibility and function of the data exchange interface between the two systems. Interface compatibility testing accounts for around 15% of total accreditation cost. The consequences of the policy option are that this cost could be cut by two thirds so **we evaluate possible cost savings at around 10% of the total cost of accreditation**

- Another measure included as part of the policy option stipulates that the test environment for OBUs should be provided by the toll charger (measure number 9). This would make it possible for EETS providers, having procured a certified OBU, to skip the OBU compatibility tests. This cost item accounts for around 5% of the total accreditation cost so **we evaluate a possible cost saving of 5% of the total cost of accreditation**
- Finally, the harmonised accreditation practices across the different toll domains, as well as the limitation of the duration of the accreditation procedure, could lead to a reduction of the workload required for the evaluation of the various components of the accreditation process, as well as the possibility of re-using the same tools between accreditation activities for different toll domains. **We evaluate the possible cost savings at up to 25% of the total cost of accreditation.**

**The combination of all the measures associated with PO1 and PO2 could thus lead to a reduction in accreditation costs for EETS providers of up to 40%.** This figure could however fluctuate from one toll domain to another, as the proportion of unavoidable cost items in the total may vary (e.g. end-to-end tests, certification fees covering the expenses of toll chargers, etc.).

The average unit cost for accreditation is around €100k for a DSRC toll domain and €1m for a GNSS toll domain (based on the Viapass example). **The possible cost savings for EETS providers could therefore be around €40k per DSRC toll domain and €400k per GNSS toll domain, which in turn could mean a possible total cumulative cost saving for EETS providers of around €7m<sup>55</sup> by 2025.**

#### 4.1.3.1.2 Remuneration of EETS providers

Based on the experiences of Viapass in Belgium and of the former “Ecotaxe” in France, as well as the current talks between toll chargers and EETS providers on the subject, **we can assume that, in the self-regulatory context of PO1, a variable remuneration amounting to c. 4% to 6% of the collected toll in GNSS toll domains and c. 1% to 2% for DSRC toll domains, could be agreed upon.** Indeed, this is the range of rates set by Viapass, which is seen as too low by most EETS providers, but is however a reasonable common ground above which an agreement would most likely be difficult.

As an example, if we apply a 4% rate to Germany, with the EETS penetration rate projections we made for PO1 (10% in 2020 and 20% in 2025) and the observed total amount of tolls collected in the country in 2015 of €4.5bn, **we can estimate the total potential remuneration for EETS providers in Germany to be up to €18m in 2020 and €36m in 2025.** The approximate scale of this additional remuneration at the EU-level (both for HGVs and LDVs) can be estimated at **around €300m annually by 2025 in this scenario<sup>56</sup>.**

#### 4.1.3.1.3 Other possible economic impacts

Other measures related to policy options 1 and 2 could have economic impacts for EETS providers as they tend to facilitate their service model, reduce their barriers to entry into new markets and thus reduce their labour costs or IT investment, for example:

- Measure number 5 on the standardisation of the information exchange interface between EETS providers and toll chargers for new or renewed tolling schemes, would allow reduced investment in the interfacing of EETS providers’ system to the toll chargers’ systems and related system adaptations;
- Measure number 7 on the reduction of the maximum duration of accreditation procedure and clearer definition of the rules, would allow a reduction of the time to market for EETS providers, which would generate cost savings and quicker return on infrastructure investments;

<sup>55</sup> This estimation is based on the assumption that three groups of four EETS providers will go through accreditation procedures in respectively 3 GNSS toll domains and 8 DSRC toll domains, 2 GNSS toll domains and 6 DSRC toll domains, 4 DSRC toll domains.

<sup>56</sup> Based on the figures on Toll Revenues by countries available in the Support Study for the Impact Assessment Accompanying the Revision of Eurovignette Directive 1999/62/EC (Ricardo, 2017) and on the ASECAP website

- Measure number 13 on the adoption of standardised electronic user registration forms would reduce the required effort for EETS providers in registering users;
- Measure number 18 on providing services to light duty vehicles would extend the potential market for EETS providers;
- Measure number 21 on the acceptance by toll chargers of former OBU versions when they are already in operation would support EETS providers' control over investment costs, as the lifetime of their OBUs would gain more certainty.

These measures seem likely to be agreed upon in a self-regulatory context, but their application could be quicker and their effect stronger through legislation.

#### 4.1.3.2 Policy option 2: Market correction entirely through legislation

##### 4.1.3.2.1 Accreditation procedure

In the context of PO2, the extent of the potential savings per accreditation procedure is similar to PO1. We can however assume that the pace of the implementation would be quicker in legislation-based policy than in the self-regulatory context of PO1 and that the number of accreditation procedures on which the effect of this category of savings will be applied would be higher. As such, **total cumulative cost saving for EETS providers of over €10m<sup>57</sup> by 2025** can be estimated.

##### 4.1.3.2.2 Remuneration of EETS providers

In the context of PO2, with the introduction of legislation and stronger bargaining power of EETS providers due to the backing of the Commission to allow greater opening up of the EETS market, **we assume that remuneration could reach at least 5% of collected tolls in GNSS toll domains and c. 2.5% in DSRC toll domains**. As the number of toll domains covered by each of the EETS providers would be larger in PO2 than in PO1 (as well as the number of OBUs operated by them), the business case for the EETS providers would be even more beneficial (i.e. the remuneration per OBU will be higher).

**Taking the same example of Germany**, with the assumption of a 5% remuneration rate and the EETS penetration rate projections we made for PO2 (30% in 2020 and 60% in 2025) and the observed total amount of tolls collected in the country in 2015 of €4.5bn, **we can evaluate the total potential remuneration for EETS providers at €68m in 2020 and €135m in 2025**. The approximate scale of this additional remuneration at the EU-level (both for HGVs and LDVs) can be estimated at **around €700m annually by 2025 in this scenario**. This significantly larger figure than in PO1 is due in part to the increased percentage of revenues likely to be directed as remuneration to EETS providers, but also due to the significantly larger extent of total toll revenues collected by EETS providers in PO2.

#### 4.1.3.3 Policy option 3: Interoperability through strict standardisation and specific measures on cross-border enforcement of tolls

##### 4.1.3.3.1 Accreditation procedure

In PO3, we evaluate **the cost reduction potential due to standardisation at up to 50%**, which would mean a possible total cumulative cost saving for EETS providers of **up to €14m<sup>58</sup> by 2025**.

On top of the above-mentioned impacts, the standardisation of all the interoperability constituents (OBUs, roadside infrastructure, enforcement and back-offices) would limit the scope and costs of accreditation activities and tests. This is especially the case for field tests, as well as technical administrative requirements for OBU and interface compatibility.

##### 4.1.3.3.2 OBU Procurement

In the context of a standardised environment, EETS providers would benefit from a more harmonised market for OBU procurement. However we cannot foresee a drastic decrease in the cost of OBUs in

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<sup>57</sup> This estimation is based on the assumption that three groups of 4 EETS providers will go through accreditation procedures in respectively: 3 GNSS toll domains and 8 DSRC toll domains; 2 GNSS toll domains and 6 DSRC toll domains; 4 DSRC toll domains (representing the likely fullest extent of EETS deployment by 2025). We also assume that the measures impacting the accreditation procedure costs will start to take effect from 2019.

<sup>58</sup> This estimation is based on the assumption that three groups of 4 EETS providers will go through accreditation procedures in respectively: 3 GNSS toll domains and 8 DSRC toll domains; 2 GNSS toll domains and 6 DSRC toll domains; 4 DSRC toll domains (representing the likely fullest extent of EETS deployment by 2025). We also assume that the measures impacting the accreditation procedure costs will start to take effect from 2019.

the medium-term as the OBU manufacturer market would be even more concentrated than today and due to the technological enhancement of the OBUs (towards more features and OBU-based services). The harmonisation of the OBUs would instead mean operational cost reduction for EETS providers (e.g. logistics, stock management, maintenance).

#### 4.1.3.3.3 Remuneration of the EETS providers

It is not clear what the impact of PO3 would be on the remuneration of EETS providers. We can however anticipate limits on the fees granted by the toll chargers as they would be subject to large investments on their side (see Section 4.1.2.3) and may thus try to limit as much as possible the share of toll revenue to be transferred to EETS providers.

#### 4.1.4 Impact on OBU manufacturers

Under PO1 there is some reduction in the number of national OBUs in use by vehicles on international journeys compared to the baseline, from 1.6m in 2016 to 900k in 2025, as shown in Table 4-14 which illustrates the number of EETS and national OBUs in each modelling year for the baseline and the three policy options. In addition the number of EETS OBUs in use on international journeys increases by c. 160,000 units across all toll domains by 2025 compared to the baseline. However the changes in PO1 are not as significant in comparison to the other policy options. As such, OBU manufacturers could continue selling national OBUs albeit at a reduced rate and would have limited opportunities to sell the more expensive EETS OBUs by 2025

Under PO2 there is a significant reduction in the number of national OBUs in the market for international journeys versus PO1 (from 1.6m to 400k), as the legislated measures aimed at tackling market barriers take effect, technical interoperability increases and the penetration of EETS OBUs takes off. Whilst this would constitute a success for improving competitiveness in the market and achieving the aims of EETS, it would mean a reduced opportunity for OBU manufacturers in terms of the total number of OBUs sold. However, a larger number of more complex (and therefore more expensive) EETS OBUs would be sold than in PO1 (650k for vehicles on international journeys in PO2 compared to 450k in PO1 in 2025), which may make up for some of the reduction in the number of (cheaper) national OBUs.

Under PO3 there is a further reduction in the number of national OBUs in use by vehicles on international journeys compared to PO2 (from 400k in PO2 to 280k in PO3 in 2025), but the trajectory in the uptake of EETS OBUs is estimated to be broadly similar as in PO2. As such, the overall impact on OBU manufacturers is likely to be negative in PO3 compared to PO2.

Secondary impacts such as the reduction in the total number of OBUs leading to consolidation in the market place and reduced competition could to some extent counter the negative effects associated with lower sales. However, a more level playing field for market participants and economies of scale could provide a counter-balancing downward pressure on costs, so it is not possible to say with certainty whether the overall impact would be positive or negative.

**Table 4-14: Number of national and EETS OBUs used by vehicles on international journeys in the baseline and policy scenarios**

Number of OBUs (1,000s)	2016	2020	2025
Baseline National	1,598	1,397	1,203
PO1 National	1,598	1,292	928
PO2 National	1,598	881	411
PO3 National	1,598	881	284
Baseline EETS	215	290	379
PO1 EETS	215	309	456
PO2 EETS	215	447	650
PO3 EETS	215	447	650

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### 4.1.5 Innovation impacts

The measures outlined in each policy option have the potential to both stimulate and restrict innovation. The following sections will discuss how the relevant measures may impact on the innovation opportunities and the development of technologies and systems required to implement EETS.

#### 4.1.5.1 Policy option 1: Correction of regulatory failures, soft measures and self-/co-regulation

While many of the measures outlined in PO1 do provide some stimulation for innovation and some direction for which those innovation investments can be made, only the measures aimed at regulatory failures are implemented through legislation. Given the self-regulation of the various market failures identified, there is still potential for technological divergence and for a lack of interoperability to persist. Specific impacts on innovation of the various legislative measures aimed at regulatory failures are discussed below:

- Through removing the mandatory requirement for EETS providers (measure number 1) to roll out services to all EU markets in a short time period, there can be more focus on early deployment, which could lead to increased opportunities for localised innovation. These innovations could then be rolled out to other Member States.
- Allowing the separation of an EETS provider offering to LDV users only or HDV users only (measure number 3) potentially supports greater innovation as the operator can focus on tailored opportunities in each category.

The other measures in PO1 are based on resolving market failures through self-regulation. Given that these are not implemented by legislation in PO1, but are in PO2, these are expected to have a less significant impact in PO1 and are therefore discussed in more detail in PO2.

#### 4.1.5.2 Policy option 2: Market correction entirely through legislation

- In addition to measures 1-3 as outlined above, which are aimed at resolving the regulatory failures associated with EETS and included in PO2, PO2 also includes a number of legislative measures aimed at resolving the market failures identified. Some of these measures will directly support innovation and many potentially enable innovation through increased transparency and removing barriers to the development of EETS. Specific impacts on innovation of the various legislative measures aimed at market failures are discussed below: Stipulating that Member States cannot make specific requirements on how the technologies are used (measure number 4), should allow for manufacturers to pursue innovation whilst still meeting KPIs from toll chargers, rather than more restrictive development in order to be compliant with a specification delivered by a particular Member State.
- The stipulation that there must be interoperable application profiles for information exchange (measure number 5), a standard format for toll domain statements (measure number 8), harmonised accreditation procedures (measure number 11) that include the interoperable constituents (measure number 10), testing requirements published nine months in advance (measure number 7), test cycles that are no longer than six months (measure number 7) and that toll chargers must provide testing facilities for OBU manufacturers to fine tune their equipment (measure number 9) will all serve to increase the interoperability of OBU equipment. This is because new entrants, as well as incumbents, will have earlier access to market requirements and specifications so they can develop interoperable innovations. Shorter test cycles will also allow innovations to be brought to market more quickly, whilst certification that applies in multiple markets will reduce the complexity and cost of testing and thereby potentially reduce barriers to bringing new innovative products to market. Overall, these measures will provide a stable system for interfacing with EETS providers allowing for innovation to be focused on other elements.
- Using the Reseller model in the contractual relationship with the EETS provider (measure number 12) reduces complexity of billing and back office systems, therefore reducing barriers to innovation in that space. This is enhanced by the adoption of a standard road user electronic registration format (measure number 13).
- By increasing transparency in relation to services provided by toll service providers and associated remuneration through measures such as providing a list of services performed by EETS providers (measure number 15), innovation can be targeted at specific service offerings, with more confidence as to the business case supporting the innovation.



- Finally, there are stipulations about the exchange of information between Member States for the purposes of recovering toll charges and fines (measure numbers 19, 20 and 22) that would pose a potential for innovation to be introduced to streamline the process of reclaiming toll penalties.

However there are some measures that are likely to restrict the potential for technical innovations and innovative solutions to come to market, including:

- Requiring consultation with the Commission and EETS providers before toll charging criteria can be added or amended (measure number 6). This will complicate the introduction of new innovative toll charging schemes, for example based on emissions technologies. It also reduces the certainty and increases costs to bring these innovations to market, thereby potentially reducing the incentive for innovation in the field.
- By ensuring that the application of the latest version of a standard must not be a source of discrimination for EETS regarding their ETC services (measure number 21) innovation could be restricted as older technology can still be used.

#### 4.1.5.3 Policy option 3: Interoperability through strict standardisation and specific measures on cross-border enforcement of tolls

Under PO3 there is potential for some innovation, although this would need to be consistent with the approved standards. Given the highly restrictive nature of these standards, any innovation would need to be carefully targeted and brought to market with the broad backing from industry and the Commission. This is generally likely to have a negative overall impact on innovation, given the likely costs of rolling out such changes across the entire EU ETC market and the uncertainty that any innovations will be accepted by all the stakeholders required for them to be brought to market. However, should innovations prove to be of sufficient value to be deployed, there is a much greater certainty that these innovations will provide a return on investment, given the large market for their deployment.

Additionally, there remains the possibility for innovation in the field of toll fraud and penalty reclamation under the prescribed mandatory mechanism for information exchange between Member States for the purposes of addressing toll evasion and fraud – as in PO1 and PO2.

#### 4.1.6 Competitiveness impacts

Removing a barrier to the deployment of EETS and enabling the expansion of the scope of EETS should allow new entrants to the market and so increase competitiveness, a key aim of the changes envisaged.

##### 4.1.6.1 Policy option 1: Correction of regulatory failures, soft measures and self-/co-regulation

While many of the measures outlined in PO1 provide some stimulation for competition, only the measures aimed at regulatory failures are implemented through legislation. Given the self-regulation of the various market failures identified, there is still the possibility that barriers to entry remain in place and for a lack of interoperability to persist in the wider market, with the likely emergence of regional EETS markets. Specific impacts on competitiveness of the various legislative measures aimed at regulatory failures are discussed below:

- Through removing the requirement for EETS providers to cover multiple Member States (measure number 1) there is the potential to increase competition as this costly barrier to entry is reduced, thereby encouraging more EETS providers to enter the market.
- The measure allowing EETS providers to offer HDV-only or LDV-only services (measure number 3) will increase interoperability, which is more likely to increase the number of EETS providers covering each market, thereby increasing competition within each market. This measure also means providers can create a more competitive offer aimed at specific markets.

The other measures in PO1 are based on resolving market failures through self-regulation. Given that these are not implemented by legislation in PO1, but are in PO2, these are expected to have a less significant impact in P01 and are therefore discussed in more detail in PO2.

##### 4.1.6.2 Policy option 2: Market correction entirely through legislation

In addition to measures 1-3 as outlined above, which are aimed at resolving the regulatory failures associated with EETS and included in PO2, PO2 also includes a number of legislative measures aimed at resolving the market failures identified. Using legislation to correct market failures will improve interoperability, and so contribute to the delivery of a level playing field. It should also reduce barriers

to entry. The various legislative measures that specifically increase the competitiveness of the market are discussed below:

- The measures aimed at increasing interoperability through standardising the application profile for information exchange (measure number 5), standardising the certification process (measure number 7), standardising toll domain statements (measure number 8) and standardising the electronic registration of road users (measure number 13), will all serve to increase interoperability and reduce market entry barriers, thereby supporting competition within and between Member State toll domains due to the likely increase in the average number of EETS providers per market.
- The measures designed to simplify and streamline accreditation procedures are likely to support competition among OBU manufacturers, whilst also reducing costs for EETS providers to enter new markets and therefore reduce barriers to entry and increase competition. These measures include harmonising testing procedures (measure number 10 and 11), reducing the time required for test cycles (measure number 7) and requiring toll chargers to provide testing suites for new OBUs (measure number 9).
- Legislation that ensures that a non-exhaustive list of services performed by EETS providers, and which must be remunerated by the road manager at market value, is published (measure number 15), will increase the transparency of services and remuneration available. This is likely to allow new entrants (or existing suppliers) to target more precisely potential market opportunities, thereby increasing the number of players in the market, as well as business innovation and increasing competition.
- A measure is designed to ensure that all EETS clients must have access to the same rebates and frequent-user schemes as clients of the national toll service provider (measure number 16). This will support comparability of services and allow foreign EETS providers to offer equally compelling pricing to their customers, thereby increasing competition.
- The stipulation that EETS Providers are only required to provide toll chargers with the minimum information necessary to calculate and apply the charge (measure number 17) will enhance interoperability and therefore potentially lead to a greater number of EETS providers, thereby increasing competition.
- The various measures to assist in the recovery of tolls from toll evaders across borders (measure numbers 19, 20 and 22) will reduce toll evasion costs to toll chargers and EETS providers, with these savings potentially being passed onto road users. This has the potential to help level the playing field between national and foreign EETS providers, thereby increasing competition in the market. Additionally, foreign drivers will no longer have such an advantage versus domestic drivers in terms of being held liable for tolls and associated toll evasion fines. This will help to ensure a level playing field for haulage companies operating across borders.

#### 4.1.6.3 Policy option 3: Interoperability through strict standardisation and specific measures on cross-border enforcement of tolls

Ensuring that all OBUs, EETS providers and toll charging systems follow strict standards under PO3 guarantees interoperability, delivering a level playing field for all EETS providers. This should increase competition both within Member States and across borders. Additionally, the various measures aimed at assisting in cross-border toll recovery will also help to increase competition in the EETS and haulage markets, as discussed under PO2.

#### 4.1.7 SME impacts

The biggest impact on SMEs from the revised EETS legislation will be the impact on SME international road haulage companies, given the large proportion of the industry that is made up of SMEs (>97% of EU haulage companies according to Eurostat) and the significant savings that HGV operators make under the various policy options, with a NPV of €92m, €301m and €408m by 2025 respectively for PO1, PO2 and PO3, for HGV road users. The impacts on road users are discussed in detail in Section 4.1.1 above.

However, the changes implemented by the legislation are likely to also have a (smaller) direct effect on other SMEs, in particular EETS providers and OBU manufacturers. As investment costs are reduced for EETS providers through increased interoperability, more SMEs should be able to enter the EETS market. However as OBUs can be used across multiple markets fewer OBUs will be needed overall

which could potentially benefit the larger mass-producers of OBUs who can afford to invest in EETS-compatible OBUs, whilst adversely affecting some SME OBU manufacturers. Due to the different impacts on these two sets of SMEs the analysis below discusses the impacts on EETS providers and OBU manufacturers for each measure.

#### 4.1.7.1 Policy option 1: Correction of regulatory failures, soft measures and self-/co-regulation

While many of the measures outlined in PO1 have some impacts on SMEs, only the measures aimed at regulatory failures are implemented through legislation. Given the self-regulation of the various market failures identified, these measures are less likely to have a significant impact on SMEs. Specific impacts on SMEs of the various legislative measures aimed at regulatory failures are discussed below:

- The removal of mandatory coverage requirements across multiple Member States (measure number 1) will provide both OBU and EETS SMEs more opportunities to enter individual or regional markets without the need to rapidly expand and thereby incur the associated significant investment costs. This lower investment associated with entering the EETS market is likely to be beneficial to SMEs.
- Overall for PO1, the total number of OBUs is likely to decline compared to the baseline given increased interoperability and this may also have a detrimental effect on OBU manufacturers of all sizes, including SMEs. However, for EETS providers it reduces barriers to entry and creates a larger marketplace to expand into and therefore increased opportunities for SMEs.
- Allowing EETS providers to offer services for HDV only or LDV only (measure number 3) creates a positive impact on OBU manufacturers as it may lead to a greater number of OBU designs (some potentially designed for niche markets) and less convergence around one design. For EETS providers it reduces the barriers to entry (by only requiring an SME to provide services for one group or the other) and allows EETS providers to target specific opportunities, thereby offering them additional opportunities.

The other measures in PO1 are based on resolving market failures through self-regulation. Given that these are not implemented by legislation in PO1, but are in PO2, these are expected to have a less significant impact in P01 and are therefore discussed in more detail in PO2.

#### 4.1.7.2 Policy option 2: Market correction entirely through legislation

In addition to measures 1-3 as outlined above, which are aimed at resolving the regulatory failures associated with EETS and included in PO2, PO2 also includes a number of legislative measures aimed at resolving the market failures identified. The additional certainty and level of enforcement brought about by introducing the policy measures through legislation rather than self-regulation would provide SMEs in both the OBU and EETS provider markets with reduced risks for market entry. The following legislative measures aimed at resolving the market failures to improve interoperability are likely to impact SMEs:

- Many of the legislative measures under PO2 will increase interoperability and reduce barriers to entry thereby creating an increased marketplace for EETS providers to operate in and increased opportunities for SMEs. At the same time increased interoperability allows OBU manufacturers to develop technologies aimed at a wider range of toll domains, thereby increasing their market and associated revenues. However this could reduce the total number of OBUs on the market and therefore decrease the opportunities for SME manufacturers, whilst also potentially benefitting larger manufacturers with more resources to ramp up production to large volume. These factors include ensuring interoperable application profiles for information exchange (measure number 5), standard formats for toll domain statements (measure number 8), accreditation procedures that support conformity to interoperable standards and that apply across toll domains and Member States (measure numbers 10, 11 and 21), introducing a standard format for road user registrations (measure number 13), regulating the information provided by the OBU and EETS providers for generating toll charges (measure number 17), allowing LDV EETS providers to also provide services for other toll collection schemes (such as congestion charging) (measure number 18) and ensuring that the latest version of a standard cannot be used to discriminate against an EETS provider (measure number 21).
- A number of measures support interoperability through simplifying and harmonising accreditation and test procedures (measure numbers 7, 10 and 11), provision of dedicated testing areas in each toll domain (measure number 9) and reduced costs through reducing the length of time to achieve accreditation (measure number 7). All of these measures reduce costs

and barriers to entry for OBU manufactures and EETS providers alike, which could support market entry for SMEs in both these markets.

- Providing a non-exhaustive list of services performed by EETS providers which must be remunerated by the road manager at market value (measure number 15) will increase transparency in the market, which is likely to support SME EETS or other service providers to target specific services in the ETC value chain, based on a sound understanding of the opportunities available and likely business case for targeting these markets.
- The measure that ensures that any rebate scheme proposed by the toll charger or by the Member State is available to all EETS clients regardless of their origin (measure number 16) will help to ensure that SME EETS providers are not disadvantaged when entering new markets, in terms of the commercial offer they can provide their customers. This is likely to increase competition and reduce barriers to entry, thereby supporting SMEs in entering new markets.
- Measures and mechanisms that support the recovery of toll charges and fines (measure numbers 19, 20 and 22) will support SME EETS providers to recover unpaid tolls, thereby reducing their liability to toll chargers. Toll recovery is currently a difficult process, particularly across borders and this can unfairly disadvantage SMEs as they do not have the resources of larger organisations to pursue offenders. These measures therefore support creating a more level playing field for SME EETS providers to enter new markets.

#### 4.1.7.3 Policy option 3: Interoperability through strict standardisation and specific measures on cross-border enforcement of tolls

The clear set of standards introduced under this PO3 will reduce barriers to entry and increase competitiveness, which could facilitate SME EETS providers' access into various market. It will also increase the size of the market available to OBU manufactures as their equipment will be compatible with all toll domains. However, the large size of the market created by the measures implemented under PO3 may disproportionately advantage larger EETS providers and OBU manufacturers who have the resources to rapidly expand to cover a wide range of markets.

Conversely, SMEs may find that they do not have the resources to expand to cover the full range of toll domains, thereby providing a less compelling offering to their customers and potentially disadvantaging them compared to their larger rivals. Their smaller toll domain coverage may also result in lower economies of scale for SMEs compared to their larger rivals, again putting them at a disadvantage in terms of passing any savings onto their customers. Additionally, with OBUs being compatible across all toll domains, fewer OBUs will be needed which could adversely affect some SME OBU manufacturers.

#### 4.1.8 Impacts on the peripheral Member States, peripheral regions and third countries outside the EU

The European Commission providing a framework for interoperable systems could lead to decreased costs for all Member States to introduce EETS, where there is not currently a tolling system in place. This could also be the case for third countries outside the EU who could benefit from the economies of scale and replicable model for introducing EETS to their own networks. However where a tolling system has already been established there could be duplication of costs if the system does not use the same technology as is used within the EC framework. Both Member States and third countries could suffer from having invested in what would now be obsolete technology depending on the policy option, which could cause issues with road users, OBU manufactures and system operators. The analysis below discusses how each of the recommended measures within each of the policy options would impact on these countries.

##### 4.1.8.1 Policy option 1: Correction of regulatory failures, soft measures and self-/co-regulation

A less prescriptive approach through soft measures and self-regulation of market failures in PO1 could mean that systems in peripheral regions are not harmonised with EU Member States the other side of the continent. However these self-regulated measures could provide an opportunity for common systems with neighbouring third countries. In addition to the soft measures targeting market failures, PO1 will also introduce legislation to remove the requirement for EETS providers to offer significant coverage across all toll domains within 24 months (measure number 1). This could encourage the development of regional arrangements between peripheral Member States and third countries.

The other measures in P01 are based on resolving market failures through self-regulation. Given that these are not implemented by legislation in P01, but are in P02, these are expected to have a less significant impact in P01 and are therefore discussed in more detail in P02.

#### 4.1.8.2 Policy option 2: Market correction entirely through legislation

The development of a clearer legislative framework for the development of EETS under PO2 provides a template on which EETS can be developed in peripheral regions and third countries alike. In addition to the legislative measures outlined above, PO2 would also introduce legislation to address the current market failures. This would provide greater certainty for the operators in the market. However there would be less flexibility for the peripheral Member States to negotiate interoperable systems with bordering third countries, should those third countries already have EETS in place that are non-compliant with the legislation. This is discussed below:

- The measure stipulating that Member States cannot define specific requirements on the way the three technologies listed in the Directive are applied beyond established standards (measure number 4) provides a consistent base for technology and standards which could reduce the implementation costs in other member states and third countries due to the economies of scale and through establishing best practice. This could result in greater interoperability in these markets, thereby facilitating the free movement of goods. However it may be more costly to implement than a bespoke option, and also render some technologies obsolete. This is also the case with the adoption of standardised formats for:
  - Information exchange (measure number 5)
  - Toll charging criteria (measure number 6)
  - Accreditation for EETS providers and certification for OBUs (measure number 7)
  - Toll domain statements (measure number 8)
  - Accreditation that certifies interoperability (measure number 10)
  - Contractual relationships between EETS providers and toll domains (measure number 12)
  - Information required from EETS provider to calculate the toll (measure number 17)
- Harmonisation in the testing procedures and provision of testing facilities for OBU technology within each toll domain (measure number 9) should allow for greater interoperability with the peripheral Member States as they will be able to test existing OBU technology and implement interoperable solutions. There may be an increased cost to toll chargers who have to provide the facility.
- Legislating for the separation of accounts between the operator of the toll collection system and the toll service provider, when both roles are performed by the same company (measure number 14) as well as the provision of a non-exhaustive lists of services performed by EETS providers which must be remunerated by the road manager at market value (measure number 15), should provide greater transparency on the costs and opportunities for service provision and a larger pool of service providers that could support the reduction of costs for third countries to implement EETS. This is also the case for Member States.
- If EETS providers must disclose upon request to system operators the identity of presumed toll offenders (measure number 19) then it means that EETS providers from third countries will need to comply with these rules if they are operating within the EU. This could require some investment in the appropriate systems and it also means that drivers from other Member States and third countries may be more likely to be subject to fines than before, thereby removing their current advantage relative to locally-registered drivers/vehicles. This is also the case when introducing a mechanism for mandatory assistance by the responsible authority within the Member State or country (measure number 20). In the case of a mechanism to exchange this information (measure number 22) there may be a requirement for centralised data logs of vehicle owners for the purposes of issuing fines, which would require further investment by Member States and (if applicable) third countries alike.

#### 4.1.8.3 Policy option 3: Interoperability through strict standardisation and specific measures on cross-border enforcement of tolls

The prescriptive standards introduced under PO3 are unlikely to apply to all existing systems within peripheral Member States and third countries. The Impacts on these countries and systems would

depend on the transition period allowed for the implementation of compliant EETS, but may require significant additional investment in infrastructure to achieve compatibility, as would be the case for toll chargers / Member States within the EU.

#### 4.1.9 Overall economic impacts

This section presents the overall economic impact for all three policy options analysed. The results obtained from the quantitative modelling of impacts related to road users have been combined with the estimates of costs and benefits to toll chargers derived from the model developed in Task 1.3. Note that due to their approximate nature based on simple assumptions, impacts on EETS providers, impacts on toll evasion and the various other impact categories considered are not included in the overall impacts analysis. The results, illustrated in Table 4-15, show that:

- PO2 generates the highest **NPV**, at **€235m**, with the majority of these benefits accrued by road users, despite some significant costs to toll chargers.
- Both other policy options show negative overall **NPVs**:
  - PO1 ranks second of the three options, showing a negative **NPV** equal to **-€134m**. Compared to PO2, the benefits for road users reduce to €117m, a 70% reduction compared to PO1, whilst costs to toll chargers increase from €174m in PO2 to €262m in PO1, due to lower levels of interoperability in PO1.
  - PO3 generates the highest total present benefits for road users at €408m, however the **NPV** is significantly negative at **-€437m**, primarily due to the very large costs to road chargers for upgrading their infrastructure to accommodate the unified standards under PO3, which have a present value of -€886m.

**Table 4-15: Total net present value of costs and benefits to road users and toll chargers under all policy options**

NPV	Policy option 1	Policy option 2	Policy option 3
Road users	117,387,440	370,479,703	407,652,410
Toll chargers	-261,570,082	-174,380,055	-885,801,518
Toll charges (savings from reduced management of national OBUs)	9,929,137	39,290,672	41,448,233
<b>Total</b>	<b>-134,253,505</b>	<b>235,390,320</b>	<b>-436,700,876</b>

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## 4.2 Social Impacts

### 4.2.1 Employment impacts

There are likely to be both positive and negative impacts on employment from the various policy options. Jobs could be lost as a result of the harmonisation activities targeted by the updates to the EETS legislation. However, jobs are likely to be gained as a result of the innovation and potential expansion of EETS that would be facilitated. There is the potential for wider job creation, as barriers to cross-border movement would be reduced. The job categories most likely to be directly affected by the expansion of EETS under the various policy options include:

- **Jobs linked to the provision of EETS**, either through toll chargers or toll service providers (including EETS providers)
- **Jobs with road haulage companies**
- **Jobs with OBU and other ETC technology manufacturers and associated R&D community**

Regarding the first category of jobs listed above, the impacts on two specific roles can be estimated quantitatively at a high level, as follows:

- **Toll booth operator jobs:** There has been a general trend for the number of human toll booth operators to decrease year after year in Europe since the turn of the century. This is because the majority of toll operators have started to introduce automated toll gate systems and ETC. Specific advances that have contributed to this include:
  - Users can now pay automatically by cash, debit/credit cards or petroleum cards at automated toll booths. The next expected step is the extension of seamless debit/credit card transactions lower than €20 or €30 that will limit the requirement for maintenance at the automated payment terminal.
  - On DSRC toll domains, toll operators have implemented dual automated toll gates that can serve both trucks and passenger cars. This introduction of ETC has acted to further reduce the needs for human operators.
  - Toll operators have also developed full video systems to monitor multiple toll gates at a central monitoring/control office, allowing some toll booths to offer support systems only via voice link, with no physical human presence at all.

Overall, many toll systems have reached a point where human operators are only present at some specific sites during peak times such as weekends or holiday seasons and this trend is expected to continue and is likely to be accelerated by the wider deployment of EETS. However, despite the reduced need for toll booth operators, anecdotal evidence suggests that job losses from automation have been for the most part reabsorbed as former toll operators are re-trained for new positions such as customer support or security. Consequently we do not anticipate any significant additional impact on the number of employees at toll booths under any of the three policy options in comparison to the base line.

- **EETS provider jobs:** The reduction of market entry barriers, as well as reduced costs for EETS providers through improved technical interoperability between markets, should lead to EETS providers entering new markets and expanding their service offerings. The tolling activity of many EETS providers is one activity amongst a range of activities (e.g. fuel cards, fleet value added services, etc.) and it is therefore difficult to evaluate the impact on them in terms of employment due to improved interoperability with additional toll domains. However, based on our understanding of their operations gained during Task 2, we can expect that each new entrant would have approximately two additional employees per market entered. Under the model assumptions the maximum level of penetration for EETS is for twelve EETS providers servicing 7.5 markets on average each by 2025. This would result in the creation of approximately 180 additional jobs, which clearly is insignificant at the European level.

There will also be a team of specialists required to support each EETS provider through the accreditation process in each market. We estimate a team of eight people per market to support the first year of implementation, but these roles would be of a temporary nature.

For the remaining job categories, the impacts are discussed semi-quantitatively and qualitatively in the sub-sections below. Where possible we have attempted to identify the mechanisms by which jobs may be created or lost for each measure associated with each policy option.

#### 4.2.1.1 Policy option 1: Correction of regulatory failures, soft measures and self-/co-regulation

While the measures outlined in PO1 provide some positive and negative impacts on employment, overall it is difficult to estimate the exact number of roles created or displaced. In addition only the regulatory failures are addressed through legislation so given the self-regulation of the various market failures identified, it is less certain what the impacts of these measures will be. The specific impacts on employment of the various legislative measures aimed at regulatory failures include the impact of removing the stipulation that EETS providers must be present across a number of Member States (measure number 1). This has the potential to increase the jobs in EETS services, if the number of EETS providers increase as a result of the reduced barriers to entry. There could be a further increase in employment if new entrants are encouraged onto the market by allowing EETS providers to offer EETS for HDV only or for LDV only (measure number 3).

The other measures in PO1 are based on resolving market failures through self-regulation. Given that these are not implemented by legislation in PO1, but are in PO2, these are expected to have a less significant impact in PO1 and are therefore discussed in more detail in PO2.

In order to roughly quantify the impacts described above, we can refer to typical employment multipliers for business services/transport industries, which tend to range between 1.5 and 2.5 full time equivalent roles per million Euros (European Commission, 2012). Based on total net cashflow for road users in 2025 of around €34m under PO1, we could expect the creation of around 70 roles by 2025. Note that toll chargers are expected to see a cost of around €300m over the period to 2025 and this is likely to balance out this job impact. The overall impact is therefore estimated to be negligible at the EU level. However, PO1 does not reach the maximum level of EETS provider market penetration and so the impact on employment will be lower than that expected in PO2 and PO3.

#### 4.2.1.2 Policy option 2: Market correction entirely through legislation

In addition to measures 1-3 as outlined above, which are aimed at resolving the regulatory failures associated with EETS and included in PO2, PO2 also includes a number of legislative measures aimed at resolving the market failures identified. Using legislation to correct market failures will likely expedite and enhance the improvements in interoperability and therefore employment. In addition to those described above, the various legislative measures that specifically impact employment within the market are discussed below:

- A range of measures are aimed at improving the interoperability of the EETS market and its competitiveness. These include measures to ensure that Member States do not make specific requirements on the way the three technologies listed in the Directive are applied (measure number 4), a standard format is used for toll domain statements (measure number 8) and that the contractual relationship with the EETS provider must follow the "Reseller model" (measure number 12). These and other measures aimed at improving interoperability and competitiveness in the market should lead to increased competition between OBU manufacturers as their target market increases and decreasing costs/increased revenues for EETS providers as their barriers to entry are reduced. Whilst decreased costs/increased revenues could lead to positive employment impacts for EETS providers, there could also be potential job amongst OBU manufacturers operating in a more competitive environment where fewer OBUs overall will be sold.
- New or renewed tolling schemes adopting an interface for information exchange with EETS providers based on the interoperable application profiles for information exchange (measure number 5) will also lead to increased interoperability and the benefits and drawbacks described in the above bullet point. However there could also be potential job losses in back-office tolling system developers.
- Whilst streamlining the accreditation procedure and shortening the accreditation cycle (measure numbers 6, 7 and 11) should increase interoperability with the same impacts as above, the measure that requires toll chargers to provide a test environment where the OBU manufacturer can fine tune their OBU (measure number 9) could potentially see a negative employment impact on OBU manufacturers' in-house testing teams, or independent testing facilities.



- By allowing the EETS providers offering services to LDV users to also re-sell paper and electronic vignettes and serve their customers in congestion and environmental charging schemes (measure number 18), these providers will potentially be able to achieve economies of scale and reduce costs which can lead to both job losses from efficiencies but also job creation through the multiplier effect.
- The legislation setting out the requirements for transferring data between EETS providers and toll chargers, and across Member State borders (measure numbers 19, 20 and 22), could have a negative impact on dedicated toll enforcement roles, as well as third party toll enforcement contractors. However there may also be a positive impact on employment due to the need to implement the systems for transfer of data and reclamation of penalties.

In order to roughly quantify the impacts described above, we can refer to typical employment multipliers for business services/transport industries, which tend to range between 1.5 and 2.5 full time equivalent roles per million Euros (European Commission, 2012). Based on total net cashflow in 2025 for road users of around €82m under PO2, we could expect the creation of around 160 jobs by 2025. Note that toll chargers are expected to see a cost of around €200m over the period to 2025 and this is likely to result in some job losses. Whilst significantly larger than PO1, this impact on employment remains negligible at the EU level.

#### 4.2.1.3 Policy option 3: Interoperability through strict standardisation and specific measures on cross-border enforcement of tolls

For PO3, there is greater potential for jobs to be lost as a result of standardisation given the very stringent top-down standardisation approach, as well as job losses associated with the significant costs of infrastructure upgrades. However, PO3 should also provide for the most improved competitiveness and overall expansion of the EETS market, as well as the removal of various barriers to free movement – thereby leading to job creation in some roles.

In order to roughly quantify the impacts described above, we can refer to typical employment multipliers for business services/transport industries, which tend to range between 1.5 and 2.5 full time equivalent roles per million euros (European Commission, 2012). Based on total net cashflow for road users in 2025 of around €98m under PO3, we could expect the creation of around 200 jobs by 2025.

Note that there are significant infrastructure changes required under PO3, which could reach €1bn over the period to 2025, as estimated in Section 4.1.2.3. Whilst the overall economic impact would be negative, resulting in a balancing out of the job creation from the positive impact on road users, there may be some short term job creation during the construction and implementation phase for this infrastructure.

## 4.2.2 Fundamental rights impacts

Overall, EETS should facilitate cross-border travel and so support the free movement of goods and people. The impacts on fundamental rights are discussed further for each policy option in the section below.

### 4.2.2.1 Policy option 1: Correction of regulatory failures, soft measures and self-/co-regulation

While the measures outlined in PO1 do provide some of these protections, only the regulatory failures are addressed through legislation. Given the self-regulation of the measures outlined for market failures, there is less certainty about how and to what extent these measures will be implemented. The specific measures included in PO1 are not expected to have a significant impact on fundamental rights, other than in respect of EETS facilitating cross-border travel and supporting the free movement of goods and people.

The other measures in PO1 are based on resolving market failures through self-regulation. Given that these would not be implemented by legislation in PO1, but would be in PO2, these are not expected to have a significant impact in PO1 and are therefore discussed in more detail in PO2.

### 4.2.2.2 Policy option 2: Market correction entirely through legislation

Using legislation to implement the various measures aimed at rectifying market failures should help to protect and enhance fundamental rights as more barriers to the free movement of goods and people will be removed. Improved enforcement mechanisms should deliver equal treatment of national and

foreign users, particularly relating to toll violations. The legislation would also deliver equal treatment of potential EETS providers. Specific measures that support fundamental rights are:

- Legislating for the Member States to specify the same OBU technology is used (measure number 4), harmonising information interfaces (measure number 5), regulating through the European Commission changes to toll charges (measure number 6), standardising toll domain statements (measure number 8) and ensuring that rebates are available to all EETS users (measure number 16) would all ensure that more EU citizens have access to the same cost saving opportunities, providing a more level playing field, as well as levelling the playing field for EETS providers.
- Harmonising the accreditation procedure (measure number 7), minimising the test cycle (measure number 7), ensuring that certification guarantees interoperability (measure number 10) and using the reseller model for toll chargers (measure number 12) would ensure that all applicants are processed in the same way, creating a level playing field for all organisations.
- Standardised electronic registration for road users (measure number 13) should ensure easier access to EETS services, thereby making it fairer for all road users.
- Separating the accounts of the toll collection system operator and the toll service provider (measure number 14) reduces the likelihood of monopolies controlling the value chain and should result in increased competition, which should provide a fairer service for road users and a more level playing field for businesses.
- Publishing a lists of the business services performed by EETS providers (measure number 15) increases the transparency of the market and would allow organisations an equal chance to compete for business and understand areas where they can be competitive.
- Improving the transfer of data between EETS providers and toll chargers (measure numbers 17 and 19), and between Member States with regard to enforcement (measure numbers 20 and 22) increases the chance that users that violate the system will have to pay eventually, thus ensuring that these users are not treated differently to those who pay first time, or to those users that are registered outside of the toll domain where the offence occurred.
- Legislation that states that the application of the latest version of a standard must not be a source of discrimination for EETS regarding their ETC services (measure number 21) ensures greater competition and interoperability so should help to protect equality and fundamental rights.

#### 4.2.2.3 Policy option 3: Interoperability through strict standardisation and specific measures on cross-border enforcement of tolls

Under PO3 the strict adherence to standards would be mandated through standardisation creating a level playing field for all the operators in the market, increasing competition and providing a fairer treatment for all citizens and businesses, as well as improving the cross-border flow of goods. An additional measure to ensure mandatory transfer of data between member states would also be required (measure number 22). This would increase the chance that users that violate the system will have to pay eventually, thus ensuring that these users are not treated differently to those who pay first time, or to those users that are registered outside of the toll domain where the offence occurred.

#### 4.2.3 Impacts on the protection of personal data and right to privacy

The innovation and potential expansion of EETS may have both positive and negative impacts on the protection of personal data and the right to privacy. Specific impacts are discussed per policy option in the section below.

##### 4.2.3.1 Policy option 1: Correction of regulatory failures, soft measures and self-/co-regulation

Under PO1, certain regulatory failures will be resolved through legislation, but none of these are expected to have any impact on data protection or privacy. Regarding the measures aimed at addressing market failures, these will be self-regulated through a process by which a number of objectives in the form of a memorandum of understanding could be provided to the industry and Member States as well as other interested parties. The only objective stipulated in this memorandum of understanding with relevance for the rights to data protection and privacy, concerns the point on effective cooperation of all actors (Member States, toll chargers and EETS providers) to enforce tolls by exchanging information on offenders.

As stated in Section 2.10, one general problem in relation to effective cooperation to enforce tolls on offenders is the fact that each country classifies tolls on a different legal basis, meaning that in some countries the toll is a form of tax levied by the government, in some other countries it is a fee due to a public body for using a road which it maintains, and in other countries it is a charge levied by a commercial road operator for access to particular stretch of road. Therefore, not paying the toll could be either a civil offence or a criminal offence according to the particular situation and so a different basis for the release of data could apply in different toll domains.

A memorandum of understanding (i.e. self-regulation) as proposed for PO1 would not relieve toll chargers and EETS providers from their obligation to comply with data protection rules relating to data exchange either as a civil or criminal offence under national law. Thus, national law may need to be revised to allow stakeholders to comply with the memorandum. Therefore, the memorandum would not have any impacts on data protection and privacy.

#### 4.2.3.2 Policy option 2: Market correction entirely through legislation

PO2 would attempt to solve both the regulatory and market failures with legislative means. Several aspects under PO2 have impacts for data protection and privacy.

Under PO2 it is suggested that EETS Providers would only be required to provide toll chargers with the minimum information necessary to calculate and apply the charge, namely (measure number 17): (i) the Vehicle's Licence Plate Number (including nationality); (ii) the identifier of the user account; (iii) the identifier of the On-Board Unit; and (iv) the applicable values of the vehicle's parameters upon which tariffs are modulated. In case of violation, the toll charger may request complementary information such as the address of the violator. In such a case, the EETS provider would have to provide the requested information. This provision would have a positive impact on data protection as it respects the principle of data minimisation. More specifically, Article 5 (1) (c) stipulates that "personal data shall be adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed ('data minimisation')".

Another requirement under PO2 is to establish mechanisms for the mandatory exchange of information between Member States on the identity of vehicle owners who are proven or suspected of committing fraud against the toll system (measure number 22). The mechanism should be largely based on the provisions of Directive 2015/413/EU for the cross-border enforcement of road safety related offences. Furthermore, under PO2, EETS providers must disclose upon request to system operators the identity of the presumed toll offenders who are their clients (measure number 19). This disclosure obligation is only valid in the framework of enforcement activities and the information on concerned EETS clients cannot be shared by the system operator with any of the EETS provider's competitors, even if one of the latter is part of the same organisational structure as the system operator.

The previous two requirements would have implications on the protection of personal data, as data on suspected toll evaders would be transferred from one EU Member State to another, which does not currently happen on a systematic basis. In the first instance it would imply that in those Member States where toll evasion are classified as a criminal offence, the protection of any data exchange of suspects would fall under Directive 2016/680. In those countries where toll evasion is classified as a civil offence, the GDPR would apply. In order to prevent fragmentation, it might be useful to require Member States to adopt the same approach in respect to how toll evasion is classified, although this may be helped through the obligation of EETS providers to adopt the reseller model (measure number 12). Independent of the data protection regime that applies, (and in order to mitigate risks associated with data protection), any cross-border transfer should take particular account of the specific nature of this data and mechanisms to exchange information need to take place under secure conditions and ensure the confidentiality of the data transmitted. While there is always an additional risk if data is shared with third parties, as long as the EU regulatory regime on data protection is complied with, no negative implications with the rights to data protection and privacy can be expected.

#### 4.2.3.3 Policy option 3: Interoperability through strict standardisation and specific measures on cross-border enforcement of tolls

Under PO3 exhaustive standards for all the interoperability constituents would be prepared. The standards would then be rendered mandatory by the legislation. The aim of the policy option would be to remove the issue of technological incompatibility from the equation. Similarly to the previous policy options, PO3 will also entail an element to ensure the cross-border enforcement of tolls (measure

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numbers 19, 20 and 22). Thus, impacts in relation to privacy and data protection will be the same as mentioned under 4.2.3.2 above.

## 5 Comparison of the options and preferred option

The following sections are used to compare the three policy options considered, in terms of:

- Effectiveness, i.e. the extent to which they would achieve the objectives;
- Efficiency, i.e. their overall cost-efficiency in achieving the objectives;
- A summary of their respective economic and social impacts considered.

A recommended option is then provided for the Commission to take forward.

### 5.1 Effectiveness

The analysis of the overall effectiveness of the options must consider the extent to which the objectives are achieved. The general objective of the revised problem definition is provided in Figure 5-1 below, whilst Table 5-1 maps the link between specific policy objectives and a series of operational objectives or indicators.

**Figure 5-1 General objective**

Reduce the cost of and burden linked to electronic toll collection in the EU and increase competition in the market

**Table 5-1 : Linking of objectives to key indicators**

Specific Objective	Operational Objective (indicators)
Remove market entry barriers and foster the development of a competitive market for electronic toll collection services	At least 3 service providers (registered as EETS providers or not) operating in each toll domain by 2022
	At least 6 EETS providers registered and operating in the EEA by 2022
	Reduce the average cost of accreditation per toll domain by 50% by 2022
	Reduce the average time needed for accreditation of EETS providers by 50% by 2022
	All toll chargers use the "reseller model" in their relations with the EETS providers by 2022
	At least 75% of toll chargers have implemented CEN TS 16986 for back office interfaces with EETS providers by 2022
	A standard format for registering road users to a system is used by all toll chargers by 2025
Improve the level of enforcement of tolls from foreign-registered vehicles	A functioning system of exchange of information on toll offenders between all EEA by 2022
Remove the excessive obligations on EETS providers	<i>No indicators suggested</i>

### 5.1.1 Analysis of effectiveness against all operational objectives

Table 5-2 assesses the effectiveness of each policy option against the operational objectives/indicators.

The objective of **having three service providers operating in each toll domain by 2022** is most effectively achieved through both PO2 and PO3, given that they both are likely to achieve a similar extent of EETS provision. This is also the case for the objective of **having at least six EETS providers registered and operating in the EEA by 2022**.

In terms of the objective to **reduce the average cost of accreditation per toll domain by 50% by 2022**, PO3 is the most effective option, achieving this aim as planned, whilst PO1 and PO2 achieve a slightly lower estimated reduction of 40%. The objective to **reduce the time needed for accreditation of EETS providers by 50% by 2022** is most effectively achieved by PO2 and PO3, given they legislate the changes required, compared to PO1 which involves self-regulation.

In terms of the objective for **all toll chargers to use the Reseller model by 2022**, PO2 is the only option which mandates this through legislation and is therefore the most effective option, followed by PO3, where strict standardisation is likely to support a shift towards the reseller model, and PO1 which is unlikely to have a significant effect.

The objective for **75% of toll chargers to have implemented the back office interface standard CEN TS16986 by 2022** is most effectively achieved by PO2 due to it legislating this standard. The top-down imposition of strict standards in PO2 is also very effective (though perhaps slightly less) due to the requirements for all new systems to be compliant. PO1 is least effective in achieving this objective due to the self-regulation approach adopted.

PO2 and PO3 are expected to most effectively achieve the objective of **implementing a standard format for registering road users by all toll chargers by 2025**, based on the legislation used in PO2 and top-down imposition of standards in PO3. PO1 is expected to be less effective in achieving this aim and is more likely to be effective on a regional basis.

Regarding the objective to **set up a functioning system of information exchange on toll offenders across the EEA by 2022**, PO2 is expected to be most effective, with three dedicated legislated measures enabling a smooth functioning of this process. PO3 should also be effective given the setting up of mandatory information exchange, but unless standards provide very strict rules for how this will work, it may not be as effective as in PO2. PO1 is not expected to have a significant impact in this area given the lack of any legislative measures.

Finally, the specific objective of **reducing the excessive obligations on EETS providers** is likely to be most effectively achieved by PO2, which provides a balance of legislated measures aimed at stricter standards whilst also protecting the rights of EETS providers. Whilst PO3 will remove many of the technical barriers for EETS providers through strict standardisation, it may not protect the rights of EETS providers as effectively. PO1 includes some legislative means to reduce excessive obligations on EETS providers, but many of the dedicated measures would be implemented through self-regulation, which would likely lead to a weakening of their positive effects on EETS providers.

**Table 5-2 Effectiveness of the policy options**

Key: Impacts expected

Least effective	Mid-level effectiveness	Most effective
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	PO1	PO2	PO3
Specific Objective 1: Remove market entry barriers and foster the development of a competitive market for electronic toll collection services			
At least 3 service providers (registered as EETS providers or not) operating in each toll domain by 2022	Not all toll domains opened to EETS	Maximum penetration of EETS providers (12) achieved	Maximum penetration of EETS providers (12) achieved

	PO1	PO2	PO3
At least 6 EETS providers registered and operating in the EEA by 2022	Target should be reached	Maximum penetration of EETS providers (12) achieved	Maximum penetration of EETS providers (12) achieved
Reduce the average cost of accreditation per toll domain by 50% by 2022	40% reduction in EETS provider accreditation costs by 2025	40% reduction in EETS provider accreditation costs by 2025, achieved quicker than in PO1	50% reduction in EETS provider accreditation costs by 2025
Reduce the average time needed for accreditation of EETS providers by 50% by 2022	Not reached by 2022	Test cycle <6 months under legislation constituting a > 50% reduction	Test cycle <6 months under legislation constituting a > 50% reduction
All toll chargers use the "reseller model" in their relations with the EETS providers by 2022	Unlikely to have significant impact under the MOU	High effectiveness under the legislation	Likely to be some changes to match strict standards, but not legislated
At least 75% of toll chargers have implemented CEN TS 16986 for back office interfaces with EETS providers by 2022	Increased technical interoperability of back offices via MOI	Very high adherence to standard due to its inclusion in the legislation (measure 5)	High adherence, initially from new systems being implemented due to strict enforcement of standards
A standard format for registering road users to a system is used by all toll chargers by 2025	Expect c. 50% coverage of standardised electronic registration under MOU	Expect full coverage of standardised electronic registration under legislation (measure 13)	Expect full coverage of standardised electronic registration due to strict standardisation
Specific Objective 2: Improve the level of enforcement of tolls from foreign-registered vehicles			
A functioning system of exchange of information on toll offenders between all EEA by 2022	No provisions for mandatory exchange of information, therefore no significant improvement expected	Measures 19, 20 and 22 are expected to achieve this by 2025 under legislation	Measure 22 expected to support this by 2025 under legislation, alongside strict standards
Specific Objective 3: Remove the excessive obligations on EETS providers			
	Legislated measures 1 and 3 are expected to achieve this by 2025 under legislation.	Legislated measures 1, 3, 4, 7, 11, 13, 15 and 17 are expected to contribute towards this	Despite the top-down imposition of standards removing certain barriers to entry, the strict

	PO1	PO2	PO3
	Several other measures will also contribute to easing the burden on EETS providers, but are not legislated and therefore expected to be less effective	under legislation. Several other measures will also contribute to easing the burden on EETS providers	enforcement of standards could place significant burdens on some existing EETS providers who are not able to adapt rapidly

### 5.1.2 Overall effectiveness comparison

Overall, it is clear that PO1 is the least effective option in achieving the various specific policy objectives set out by the Commission.

PO2 and PO3 are both very effective in achieving the specific objectives, with some operational objectives better achieved by PO3 and others by PO2 for specific objective 1 in particular (“Remove market entry barriers and foster the development of a competitive market for electronic toll collection services”).

However, for specific objective 2 (“Improve the level of enforcement of tolls from foreign-registered vehicles”), PO2 is slightly more effective than PO3 given the wider range of legislative measures aimed at improving cross-border toll enforcement. For specific objective 3 (“Remove the excessive obligations on EETS providers”), again PO2 is more effective, due to its inclusion of specific legislative measures aimed at protecting the rights of EETS providers and reducing the excessive obligations placed on them by the current legislation. In this case, PO3 could potentially introduce additional burdens due to the strict imposition of standards which could have a significant cost to EETS providers.

Overall therefore, it can be concluded that, whilst both PO2 and PO3 are very effective in achieving the specific objectives of the Commission, **PO2 is the most effective of the three policy options considered.**

## 5.2 Efficiency

Efficiency can be defined as “the extent to which objectives can be achieved for a given level of resource/at least cost”. There are significant economic impacts under each policy option for the three main stakeholder groups (road users, toll chargers and EETS providers).

The major costs of the policy options come in the form of investments by toll chargers to install interoperable systems and procedures, as well harmonising accreditation procedures. These additional costs can be balanced against the additional revenues generated/reduced costs by EETS providers, benefits to toll chargers from reduced toll evasion and reduced costs for road users due to greater interoperability and improved competitiveness in the market. The costs and benefits to the three main stakeholder categories are summarised in Table 5-3 below.

Overall, **PO2 is the most efficient policy option**, providing some of the largest benefits to road users, toll chargers and EETS providers, alongside the smallest additional costs to toll chargers. This is followed by PO1, which although providing relatively smaller benefits than PO2 and PO3, incurs significantly lower costs than PO3. PO3 is the least efficient option, dominated as it is by the very substantial investment required by toll chargers to upgrade their infrastructure in order to adapt to the strict standards imposed.

**Table 5-3 Efficiency of the policy options**

Key: Impacts expected				
xx	x	o	✓	✓✓
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive



	PO1	PO2	PO3
Benefits to road users	✓ Total NPV of €117m by 2025, annul savings in 2025 of €34m	✓✓ Total NPV of €370m by 2025, annul savings in 2025 of €82m	✓✓ Total NPV of €408m by 2025, annul savings in 2025 of €98m
Costs to toll chargers	✗ c. €300m additional costs in the period to 2025, with €12m savings over that period	✗ c. €200m additional costs in the period to 2025, with €48m savings over that period	✗✗ c. €1bn additional costs in the period to 2025, with €51m savings over that period
Benefits to toll chargers	○ No significant impact	✓✓ Possible additional revenues up to €300m per year from reduced toll evasion	✓✓ Possible additional revenues up to €300m per year from reduced toll evasion
Benefits to EETS providers	✓ c. €7m total benefits to 2025 from reduced accreditation cost Up to €300m additional revenues per year by 2025 from remuneration	✓✓ Over €10m total benefits to 2025 from reduced accreditation cost Up to €700m additional revenues per year by 2025 from remuneration	○ c. €14m total benefits to 2025 from reduced accreditation cost No significant additional remuneration expected

### 5.3 Summary of other economic and social impacts

In addition to the economic impacts described above a number of economic impacts on other stakeholders were considered as part of the analysis, as well as various social impact categories. The magnitude of these impacts varies significantly between policy options and they are summarised in the sub-sections below. Table 5-4 then provides a brief summary and scoring for each of these impact categories for each policy option, in order to help with the selection of a preferred option.

#### OBU Manufacturers

The reduction in the number of total OBUs, expected to become increasingly apparent moving between the policy options, results in a reduced overall market size for OBU manufacturers. However, the increase in the size of the market for EETS OBUs offers additional opportunities for developing more premium devices capable of interoperability across the EU.

Overall, there is an increasing likelihood of consolidation in the market place moving from one policy option to the next, reduced overall market size but countered by reduced competition. Whilst the reduced competition could lead to an increase in prices for OBUs, the smaller overall market size is likely to result in an overall increasingly negative impact for OBU manufacturers between policy options.

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## Innovation

Limiting the technology that can be used for EETS will have a potential negative impact on innovation in new technologies aimed at ETC under all three policy options, although they will be stronger under the legislation in PO2 and strongest under the strict standardisation in PO3. However the measures supporting innovation by harmonising accreditation procedures, systems and testing facilities will be stronger in PO2 and PO3 given their implementation through legislation. Increased transparency using the Reseller model and the opportunities for innovation in recovering unpaid tolls across borders from toll evaders are all likely to be stronger under PO2 and PO3.

## Competition

By harmonising the technology used, the accreditation procedures and the systems in place, each policy option improves interoperability and reduces the barriers to entry and therefore costs to enter new markets for EETS providers. Separation of accounts, increased transparency on the service provider model and on remuneration are also likely to allow for increased competition in specific market segments targeted by EETS providers.

This is likely to promote competition between markets, particularly in PO2 and PO3, where the implementation of these changes through legislation and strict standardisation respectively will be most effective.

## SMEs

The strongest positive impact on SMEs is that on road haulage companies, which are dominated by SMEs. Benefits to road users increase considerably between PO1 and PO2/PO3, with the latter providing similar levels of benefit to road users.

For other SMEs, there is a trade-off between EETS providers and OBU manufacturers as greater interoperability in general is likely to support EETS providers but limit opportunities for OBU manufacturers. For example, harmonised accreditation procedures would reduce costs for EETS providers, but increases competition amongst OBU manufacturers which could lead to consolidation in the market, favouring larger organisations that can support lower prices through economies of scale. These trade-offs for EETS providers and OBU manufacturers are equally balanced under each policy option leading to no overall negative or positive impacts.

## Peripheral states

Harmonisation and interoperability should lower costs for implementation of ETC and increase competition. This should make it easier and cheaper for Member States and third countries to implement EETS.

However if non-compatible tolling systems have already been implemented there will be costs incurred for replacing these obsolete systems or maintaining non-interoperable systems. There could also be some costs for authorities to implement information exchange and toll evasion information exchange procedures/systems, and increased costs for the road users who were previously able to avoid tolls. Under PO1 there remains potential for regional harmonisation with third countries outside the EU, which would not be possible under the legislative measure of PO2 and strict standardisation of PO3. PO3 may also involve larger investment costs for standardised infrastructure, making this option less attractive for third countries and peripheral Member States.

## Employment

There are both positive and negative impacts on employment as the changes outlined in each policy option are implemented, but no significant impacts under any of the policy options.

The cost savings and potential additional revenue under PO1 and PO2 will have a small impact on employment in the range of a few hundred roles in PO1 and perhaps twice as many under PO2. The large capital investment required for infrastructure changes under PO3 do provide an employment opportunity but this is transient and the NPV associated with these costs means that there is expected to be an overall slightly negative impact on employment under this policy option.

Other jobs affected include:

- Changes to the testing and accreditation procedures are likely to have a negative impact on the accreditation personnel working with each OBU manufacturer as there will be reduced

requirements in the differences between the testing procedures of each member state. Yet the decreased costs for testing and accreditation could provide an employment opportunity.

- With regards to booth operators, there is expected to be no significant net effect over and above what is occurring in the baseline.
- For EETS providers, whilst the various policy options undoubtedly provide support for them to create jobs, the impact at an EU level is negligible.

**Fundamental rights**

EETS should facilitate cross-border travel and so support the free movement of goods and people. The legislation provided under PO2 and strict standards under PO3 mean that road users (both businesses and the public) and EETS market operators should be treated equally regardless of origin or size. This includes protection for toll chargers in revenue lost through toll evasion, and protection for road users unfairly charged for toll evasion, whilst the increased competition and more level playing field is likely to protect the fundamental rights of all road users affected. The lack of legislation in PO1 means that the same protections cannot be guaranteed and are likely to be improved, but to a lesser extent.

**Privacy and protection of data**

The reduction of the required data that must be transferred between EETS provider and toll charger are in line with the principle of data minimisation and constitute an improvement to data privacy. This only applies to PO2 and PO3, as under PO1 the guidelines can only be applied as a memorandum of understanding and not legislation. There is an increased risk with transferring data across Member States, but compliance with the current EU regulatory regime on data protection would be sufficient to ensure no negative implication with the rights to data protection and privacy.

**Table 5-4: Other economic and social impacts**

Key: Impacts expected				
xx	x	O	✓	✓✓
Strongly negative	Weakly negative	No or negligible impact	Weakly positive	Strongly positive

	PO1	PO2	PO3
<b>Economic impacts</b>			
Impact on OBU manufacturers	O Increased interoperability reduces number of OBUs sold. Potential for market consolidation improving profits. EETS OBUs command higher prices	x Further reduction in number of OBUs sold. Potential for market consolidation improving profits. More EETS OBUs sold	x Further reduction in number of OBUs sold. Potential for market consolidation improving profits. More EETS OBUs sold
Impact on innovation	O Restrictions on technology that can be developed. Some support through harmonisation and transparency	✓ Restrictions on technology that can be developed. Increased support through harmonisation and transparency as implemented through legislation	x Increased restrictions on technology that can be developed under standards. Some support through harmonisation and transparency

	PO1	PO2	PO3
Impact on competitiveness	✓ Reduced costs through harmonisation, increased competition. Increased transparency allows market segments to be targets	✓✓ Reduced costs through harmonisation, increased competition. Increased transparency allows market segments to be targets. Legislation ensures benefits are stronger than PO1.	✓✓ Reduced costs through harmonisation, increased competition. Increased transparency allows market segments to be targets. Strict standardisation ensures benefits are stronger than PO1.
Impact on SMEs	✓ Significant benefits to road haulage SMEs. Increased opportunities for EETS provider SMEs through reduced barriers to entry and interoperability. Reduced opportunities for OBU manufacturers due to increased competition.	✓✓ Very substantial benefits to road haulage SMEs. Increased opportunities for EETS provider SMEs through reduced barriers to entry and interoperability. Reduced opportunities for OBU manufacturers due to increased competition	✓✓ Very substantial benefits to road haulage SMEs. Increased opportunities for EETS provider SMEs through reduced barriers to entry and interoperability. Reduced opportunities for OBU manufacturers due to increased competition
Peripheral MS, Regions and 3rd countries	✓ Reduced costs for implementing EETS, with more flexibility to create regional interoperability based on regional standards, thereby allowing greater harmonisation with third countries	○ Reduced costs for implementing EETS. However, potential investment costs for data exchange on toll evasion and upgrading legacy systems	✗ Likely large investment costs for infrastructure changes as well as investment costs for data exchange on toll evasion, despite reduced costs for implementing EETS.
<b>Social impacts</b>			
Impact on Employment	○ Cost savings and potential additional revenue will have a small impact on employment in the range of a few hundred roles	○ Cost savings and potential additional revenue will have a small impact on employment in the range of a few hundred roles	✗ Cost savings and potential additional revenue will have a small impact on employment in the range of a few hundred roles, however potential negated by large investment costs on infrastructure
Fundamental rights of individuals and organisation	✓ Minor improvements to fundamental rights	✓✓ Harmonised processes, fair toll charging, cross-border toll recovery arrangements mean that road users and market operators are treated equally	✓✓ Harmonised processes, fair toll charging, cross-border toll recovery arrangements mean that road users and market operators are treated equally

	PO1	PO2	PO3
Protection of the personal data and right to privacy	<p>O</p> <p>No impact on data protection as the memorandum of understanding would point to existing legislation. This legislation may need to be revised.</p>	<p>✓</p> <p>Improved data protection through the legislation in particular with regard to data minimisation. Increased risk due to transfer of member states, but compliance with the legislation would negate the risk.</p>	<p>✓</p> <p>Improved data protection through the legislation in particular with regard to data minimisation. Increased risk due to transfer of member states, but compliance with the legislation would negate the risk.</p>

Overall, based on the analysis set out above, **PO2 again is the most attractive policy option** considered, as it provides positive or neutral impacts on all the impact categories considered, except for the impact on OBU manufacturers, which is expected to be slightly negative.

In this part of the analysis, PO1 is the second most attractive option, with mildly positive or neutral impacts on all impact categories. PO3 is the least preferred option considered, given its negative impact on a number of impact categories.

## 5.4 Preferred option

The general objective of the proposed policy intervention is to “*Reduce the cost of and burden linked to electronic toll collection in the EU and increase competition in the market*”.

Through increasing the use of the interoperable EETS OBUs and encouraging a greater extent of EETS-compatible toll domains, PO2 and PO3 are far more effective than PO1 in reducing the burden linked to electronic toll collection as stated in the objective.

However, PO3 has significantly larger investment costs and a negative overall NPV, whilst PO1 also has a negative NPV, leaving PO2 as the only option with a positive overall NPV. Furthermore for the other impact categories considered, PO2 has an equal or greater positive impact than the other policy options.

Overall therefore, taking into account both effectiveness, efficiency and comparison of other impact categories, it is clear that the legislative approach in PO2 is more likely to ensure a level playing field across a wider region than the self-regulated approach of PO1, whilst its overall economic impact is also improved. Based on the Impact Assessment carried out, we can therefore **recommend PO2 as the preferred option** for implementation.

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