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PART 2/2

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

Proposal for a Directive of the European Parliament and of the Council amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures
and
Proposal for a Council Directive amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures, as regards certain provisions on vehicle taxation

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ANNEXES

1. ANNEX 1: PROCEDURAL INFORMATION CONCERNING THE PROCESS TO PREPARE THE IMPACT ASSESSMENT REPORT AND THE RELATED INITIATIVE

1.1. Organisation and timing

The Directorate-General for Mobility and Transport is the lead service for the preparation of the initiative (2016/MOVE/004) and the work on the impact assessment.

An inter-service steering group (ISG), chaired by the Secretariat-General, was set up in May 2016 with the participation of the following Commission Directorates-General: Legal Service; Economic and Financial Affairs; Internal Market, Industry, Entrepreneurship and SMEs; Environment; Climate Action; Communications Networks, Content and Technology; Joint Research Centre; Regional and Urban Policy; Taxation and Customs Union; Justice and Consumers.

Invitations were also sent to DG Competition; DG Employment, Social Affairs and Inclusion; DG Energy; DG Neighbourhood and Enlargement Negotiations.

The ISG met three times between the end of May 2016 and the end of February 2017, discussing the inception impact assessment, the terms of reference for the external study, the questionnaire for the public consultation, as well as subsequent reports of the support study and the draft impact assessment.

1.2. Consultation of the RSB

The Regulatory Scrutiny Board received the draft version of the present impact assessment report on 1 March 2017 and following the Board meeting on 29 March 2017 issued a positive opinion with reservations on 31 March 2017. The Board made recommendations. Those were addressed in the revised IA report as follows:

RSB recommendations	Modification of the IA report
(1) The introduction of a new objective on CO_2 reduction is not sufficiently justified. As stated in the evaluation and the impact assessment, road charges are not the most cost-effective way of reducing CO_2 emissions. In addition, the report does not sufficiently demonstrate the proportionality and complementarity with other environmental charges and taxes linked to the ownership and use of vehicles;	Explanations on the proportionality and complementarity in relation to other environmental charges and taxes linked to the ownership and use of vehicles have been added in section 2.2.1.
(2) The impact assessment does not treat earmarking of revenues of road charges in a consistent way. While earmarking is in principle excluded on subsidiarity grounds, the preferred option makes it mandatory in the case of congestion charges;	Explanations on the reasons for this differentiation have been added in section 11.1.
(3) The problem definition does not clearly describe the main design deficiencies of the Eurovignette Directive. It does not sufficiently explain the main obstacles for increasing Member States' uptake of road charging;	Further explanation has been added to the problem definition (section 2.2).
(4) The report lacks a clear explanation of the reasons for discarding certain options (e.g. mandatory road charging, earmarking revenues) and for introducing new reporting requirements. The report does not describe the reasons for	Explanations on the reasons for discarding mandatory road charging and generalised earmarking of revenues, as well as on phasing-

introducing phasing-in periods for different option elements and their necessary duration;	in/out measures have been added in section 11.2.
(5) The analysis does not clearly present the expected contribution of this initiative towards reducing CO_2 emissions, improving quality of roads or reducing air pollution and congestion. It does not identify whether any Member States are particularly affected and how;	The contribution towards reducing CO_2 emissions is now presented under section 6.2.1. The contribution to the necessary investment in road maintenance is presented in section 6.1.6. Most affected Member States will be those where road quality is bad, as indicated in sections 2.1.2 and 2.2.2. The contribution to reduce air pollution and congestion is described in sections 6.2.2 and 6.1.2.
(6) Although this is a REFIT initiative, the report does not sufficiently develop the possibilities for simplification of the Directive and its implementation, and the quantification of the administrative burden.	More details have been added in section 7.3 as well as under the description of options (section 5). The quantification of costs to authorities is provided in section 6.1.4.2, while the administrative/compliance costs for users in section 6.1.5.
Further considerations and adjustment recommendations	
(1) Context and problem definition The report should briefly describe how the Eurovignette Directive has worked so far and identify the main shortcomings in its design. It should explain the main obstacles for increasing Member States' uptake of road charging, including for light duty vehicles. The report should clarify why many Member States prefer time-based vignettes. It should better justify the need to extend the scope beyond HGVs.	More explanation has been added in section 1.3 as well as in section 2, the description of the problem definition, and in particular the drivers.
(2) Objectives The report should better justify the CO_2 emission reduction objective of this initiative; given that, the report recognises that internalising external costs of emissions in the fuel cost would be a better instrument. It should demonstrate the consistency with other instruments contributing to the same objective (e.g. fuel taxes, vehicle registration taxes, CO_2 emission standards) and discuss whether there might be risks of duplication. The report should clarify if the initiative has an explicit simplification objective.	An explanation on the consistency with other instruments (e.g. fuel taxes, vehicle registration taxes, CO_2 emission standards) has been added in section 2.2.1.
(3) Options The report should better explain the choices made regarding the content of the options. For example, why is an option of making road charging mandatory discarded while at the same time proposing phasing-out time-based vignettes? It should explain why revenues from congestion charging are earmarked for investment in roads or mobility solutions, even though overall earmarking of revenues from road charging has been discarded due to subsidiarity concerns. The report should better justify the introduction	Partly covered by point 2 above; more explanation has been added under the options (section 5).

of inter-urban congestion charging. It should explain why, in the absence of earmarking of toll revenues, Member States need to report on their toll revenues and expenditure on toll road maintenance to improve the overall quality of roads. In contrast, the option does not foresee reporting on the proposed road quality indicators, which risks limiting their usefulness. The report should also describe for which option elements phasing-in periods are foreseen and what would be the appropriate duration.	Reporting does include information based on quality indicators – the description has been corrected in in section 5 with more detail provided under Annex 11 (section 11.1.).
(4) Impacts The report should present what contribution is expected from this initiative towards reducing CO2 emissions from road transport, improving quality of roads or reducing air pollution and congestion. It should identify if any Member States are particularly affected and how. The report should describe if and to what extent an increased uptake of the distance-based road charging in Member States is expected (given that there is no obligation to introduce it). It should strengthen the REFIT dimension by better identifying the specific simplification potential. The report should also explain the implications of phasing-in different option elements over longer time.	The contribution of the initiative to these goals is presented in the relevant subsections in chapter 6 and summarised in section 7.1. Changes in tolling revenues (6.1.4.1) as well as transport costs (6.1.1) are presented per Member State and particularly affected Member States are mentioned in the text. An increased uptake of distance-based charging is expected and the assumptions are introduced at the end of section 5 with detailed description in Annex 4. More explanation has been added under section 7.3 on the REFIT dimension and under options. The implications of phasing-in of distance-based charging (or the phasing out time-based schemes) are explained in the discussion on the preferred option, while detailed rationale for each measure are provided in Annex 11.

1.3. Evidence

The problem definition was based on previous evaluations carried out by the Commission as well as using external expertise (evaluation of the implementation of EU infrastructure charging policy since 1995, Update of the Handbook on external costs of transport[1]), complemented by additional research used to update and substantiate the problems identified in those evaluations (see external expertise below). In particular the Handbook on external costs of transport was peer reviewed by a group of selected experts in the field, including representatives of academia.

Regarding the current situation in road charging, evidence was based on information publically available on the websites of Member States/public authorities/road operators regarding the scope and levels of road infrastructure charges. For macro-economic trends

[1] Ricardo-AEA et al (2014), Update of the Handbook on External Costs of Transport: http://ec.europa.eu/transport/themes/sustainable/studies/sustainable_en

as well as emissions, the Impact Assessment report builds on the Baseline scenario described in section 4. This Baseline scenario has been developed with the PRIMES-TREMOVE model by ICCS-E3MLab and draws on the EU Reference scenario 2016[2] but additionally includes few policy measures adopted after its cut-off date (end of 2014) and some updates in the technology costs assumptions. As regards environmental data, European Environment Agency was used as data source.

In addition, the Impact Assessment report relies on a previous Impact Assessment prepared in 2013, accompanying a proposal for Fair and efficient road pricing, which was not adopted in view of political opportunity reasons.

1.4. External expertise

As indicated above, the impact assessment work was based on previous evaluations and an impact assessment partly informed by external expertise.

Following discussions with the ISG, a public tender for the impact assessment support study was launched in June 2016 and the consultant started working on the study in September 2016. Its reports (an advanced inception report including the definition of the problems, an intermediate report including assessment of stakeholder input, and a draft final report including the assessment of all major impacts) have been scrutinised by the ISG and commented by various services of the Commission.

[2] ICCS-E3MLab et al. (2016), EU Reference Scenario 2016: Energy, transport and GHG emissions - Trends to 2050.

2. ANNEX 2: STAKEHOLDER CONSULTATION SYNOPSIS REPORT

2.1. Consultation strategy

Title:	**Impact Assessment for the revision of Directive 1999/62/EC**
Background:	Directive 1999/62/EC (the "Eurovignette" Directive) provides a detailed legal framework for charging heavy goods vehicles (HGVs) for the use of certain roads. The Directive aims to eliminate distortions of competition between transport undertakings by achieving step-wise harmonisation of vehicle taxes and establishment of fair mechanisms of infrastructure charging. Following ex-post evaluations of the current legislative framework, the Commission has to assess the potential impacts of various options for a possible revision of the legislative act in question. The consultation of stakeholders is an integral part of the impact assessment process.
Objective of the consultation	
Goal:	The objective of the stakeholder consultation was to collect the views and opinions on the approach proposed in the Inception Impact Assessment. It was used to identifying gaps in the proposed intervention logic or areas requiring further attention.
Scope:	The consultation covered all elements of the impact assessment: problem definition and respective drivers/root causes, the issue of subsidiarity and the EU dimension of the problem, the preliminary options (policy measures). The consultation also allowed asking the stakeholders on their perception of the likely impacts of each option.
Identification of stakeholders	
Stakeholders:	**Member States; Public authorities:** Transport authorities/agencies in the Member States (CEDR) **Industry and industry associations from the road sector**: - infrastructure managers: ERF (association of stakeholders involved in construction, equipment and operation of Europe's road network), - toll chargers and service providers: ASECAP (association of toll chargers), AETIS (association of prospective European Electronic Toll Service providers) - road users: IRU and UETR (associations of hauliers), FIA (association of motorists), CLECAT (association for forwarding, transport, logistics and customs services) - automotive industry and sectors dependent on transport: ACEA (association of the automotive industry), BusinessEurope, UEAPME (association of SMEs) Companies and **associations from other modes of transport**: CER (association of railway companies); UIRR (association of intermodal transport) **Environmental associations:** Transport&Environment **Citizens**.

Consultation methods and tools	
Methods:	A combination of consultation methods were used: 1) A standard 12-week **online open public consultation** was organised in between July and October 2016 via the website "Your Voice in Europe" on the basis of questionnaires. 2) **Targeted consultation with specific stakeholders and specialists** took place throughout the IA process and involved: a) **Thematic seminars with stakeholders and Member States** b) A **conference on the planned road initiatives** on 19 April 2016. The conference involved specialists, stakeholder associations as well as representatives of Member States and Members of the EP. c) 21 interviews with stakeholders selected based on specific data needs carried out by the contractor preparing the IA support study. An interview guide was agreed with the Commission.

2.2. Results of the open public consultation

The open public consultation (OPC) ran from 8 July to 5 October, although late contributions were still accepted. The OPC contained two set of questions: the first aimed at understanding the perceptions of users addressed to the general public, and a second, more technical one to experts. Respondents were also given the opportunity to provide any further comments. Some respondents also submitted additional documents providing further relevant information.

The questionnaires were based on the issues identified by the evaluation. The issues covered included the quality of road infrastructure, the fairness of road pricing (taxes and charges), the problems of congestion and CO_2-emissions, as well as the scope of EU legislation in the field. The questionnaires and statistics are available on the consultation webpage:
http://ec.europa.eu/transport/modes/road/consultations/2016-eurovignette_en

2.2.1. Objectives of the OPC

The main objectives of the OPC were: 1) to confirm/verify the problems identified during the ex post evaluation; 2) to seek the opinion of stakeholders on possible policy measures; and 3) to assess the expected impacts of the possible policy measures.

2.2.2. Statistical information

There were 135 responses to the questionnaires as well as 48 additional documents of which 27 were of relevance. These responses covered a variety of stakeholder groups, including transport undertakings and their representatives (42%), consumers/citizens and their representatives (14%), public authorities (13%), the construction industry (7%), public transport associations (4%), and tolling service/solution providers (4%).

There was a relatively high number of coordinated responses (36, i.e. 27%), following 12 different templates for answers, indicating that standard replies circulated by associations to their members and sent in high numbers.

Responses were received from respondents residing in, or organisations based in, 20 EU Member States, with the majority of responses (80%) are from EU-15 Member States. The highest number of responses was received from Belgium (24), Germany (20), Spain (19), Austria (11), and Hungary (8).

2.2.3. Main findings and position on the main potential policy measures

a. Opinions on the fairness of pricing

The majority of respondents (72%) were of the opinion that different taxes and charge systems are thought to cause market distortion, therefore supporting EU harmonisation. Transport undertakings were strongest in agreement with this, with 82% of respondents indicating that they felt that this was the case. 70% agreed that the exemption of lorries between 3.5t and 12t in some countries can distort competition.

Regarding light goods vehicles, there is mixed opinion over whether the fact that the Eurovignette Directive does not cover vans can cause market distortion within the freight transport industry. The majority of respondents agreed (54%) that this was the case, whereas 31% disagreed.

Regarding passenger cars, 60% of the respondents (85% of consumers/citizens) felt that EU rules could introduce fairness for non-resident road users to some extent or fairly significantly.

There was disagreement as to whether road users are paying enough based on these principles, with 65% of transport undertakings feeling that charges were too high, while 52% of consumers/citizens felt that charges were too low. In the case of light vehicles, respondents from EU-13 Member States felt strongly (67%) that prices are too low. This is probably linked to the prevalence of vignette schemes in those countries.

b. Scope of the rules and overall approach

The survey suggested that any legislation introduced should not be focused solely on HGVs, but on **all road vehicles** including both freight and passenger transport (54%) based on the polluter pays (75%) and user pays (80%) principles.

At the same time, only 51% agreed that the overall price of transport should cover all related externalities, with 42% were against. Consumers/citizens agreed in highest proportion (63%).

Regarding the geographic scope, 34% were in favour of applying legislation to all main or national roads, whilst 36% felt that the legislation would be best applied to road infrastructure of European importance, such as motorways and national roads carrying significant international traffic.

Regarding **congestion**, with the exception of toll service providers (strongly feeling that EU legislation should be applied, in order to address congestion on all of the TEN-T network, motorways, and interurban roads), most respondents felt that the problem should be dealt with by Member States and local authorities.

Most respondents (82%) agreed that the **revenues** generated from taxes and charges should be reinvested back into the maintenance, repair and upgrade of the road network, ensuring transparency of the process to the public. At the same time several felt that tax revenues should not be used solely for the support of infrastructure, but should be used to fund other transport-related services, e.g. public transport.

There was also broad agreement (74%) on the question whether the EU should make sure that all **vignette** prices are set proportionately.

On the way to address CO_2-emissions, many suggested the introduction of regulations covering fuel consumption and CO_2-emissions for heavy duty vehicles; that CO_2-emissions should be accounted for in fuel taxes; and that the focus should rest on taxing fuels appropriately.

In addition, there was some concern that by changing this Directive there would be a danger of 'double taxation', i.e. by another source for the same reason (e.g. annual road tax). The stakeholders believe that EU-wide harmonisation of the rules would be an ideal solution, as it would create fair competition rather than favouring companies in countries where taxes are lower.

c. On the proposed solutions

Overall the proposed changes were positively received, with the stakeholders considering all identified issues to be covered by the Eurovignette Directive as important.

1) Challenge of road maintenance

All three proposed measures received around 2/3 of approval, with monitoring and reporting of revenues and expenditures getting slightly higher mark (69%) than the introduction of rules on the liability of the keeper of the toll road, and the requirement of national plans on the maintenance and upgrade of roads (both 65%).

2) Fair pricing for HGVs

The stakeholders were proponents of phasing out vignette schemes in favour of distance-based charging for HGVs or all goods vehicles.

3) Fair pricing for other vehicles

Respondents felt the most favourable with the inclusion of light goods vehicles and buses/coaches was also suggested from the responses. Other options – including either light vehicles or buses/coaches received a lower level of approval.

4) Possible extension of mark-ups beyond mountainous regions

Responses were mixed: 32% felt that this provision should be extended, to use the revenues more flexibly, to support projects within the same corridor, or used to compensate for the higher costs linked to the use of an alternative infrastructure on the same corridor, while 29% were against. EU-15 Member States were more in favour with EU-13 respondents less so.

For some, further mark-ups may result in double charging, and no further mark-ups can be justified. If a mark-up is used in these areas, then there needs to be transparency in its calculation, with its contribution clearly separated from the base charge.

5) Measures addressing CO_2-emissions

The proposed measures for addressing CO_2 emissions from HGVs were supported by the stakeholders. The options that were most agreed with were the measures to promote fuel efficient vehicles and technologies by reduced road charges for them (68% and 66% respectively). By contrast, the only option which suffered a more mixed response was the phasing out of the EURO exhaust emissions standards. Even so, in this, 44% expressed agreement with the measure, whilst 33% disagreed.

The need for an adequate measuring methodology was widely accepted.

6) Addressing congestion

Proposals for congestion charging were met with scepticism. The greatest approval rate (40%) was given to 'allowing congestion charging for all vehicles', with the possibility to extend the application of mark-ups receiving the lowest disapproval (40%).

It was agreed that if congestion charging is applied, it should cover all vehicles, not just HGVs. Some said that congestion charging may not actually have the intended effects, as often users do not have alternatives.

d. Additional contributions

Fifty three **additional contributions** were received, of which 32 were of direct relevance. One third of the latter were from **public authorities** and nearly one quarter from **transport undertakings**.

In the additional contributions, there was a lot of **discussion of distance-based charging versus vignettes**. Most contributions supported distance-based charging and the phasing out of vignettes, as the former were best able to internalise external costs in line with the user-pays and polluter-pays principles. Other contributions underlined the greater costs associated with distance-based charging, and argued that while distance-based charging might be appropriate for HGVs, time-based vignettes were more appropriate and cheaper for other types of vehicles.

There were mixed views on the **internalisation of external costs**, with some additional contributions calling for the inclusion of external costs relating to congestion, accidents and CO_2 emissions in addition to air pollution and noise, while others believed that external cost charging was not appropriate or was difficult. For **congestion**, views ranged from support for such charges to be additional, rather than revenue-neutral, to arguing that additional provisions for congestion charging were not necessary, as the costs of congestion were already internalised by users. Some **public authorities** called for the maximum charging levels to be reviewed or even directly removed to enable charging that actually reflects the costs of pollution; a similar view was held by a motorway operator in relation to congestion. There was some support for replacing the possibility to differentiate charges by Euro emissions class with CO_2-differentiated charging, but it was noted that the latter was difficult in the short-term as a result of a lack of relevant information for HDVs. An alpine region called for mountainous areas to be allowed to implement additional tolls to cover the additional infrastructure and external costs imposed on these sensitive areas.

Views on the **use of revenue** varied between making it mandatory for revenues to be used to support the development and maintenance of transport infrastructure to a more general belief in revenues being used to decrease external costs and promote cleaner transport modes. **Member States**, on the other hand, tended to argue that the use of revenue should be left to public authorities.

There was some support for **the scope of the legislation** to be extended to buses and coaches, and even to all vehicles. Some supported the legislation being amended to require mandatory distance-based charging, although road users in particular did not support such mandatory charging. Some **Member States** supported the removal of the possibility of exempting HGVs over 3.5 tonnes and less than 12 tonnes, but did not support the extension of the Directive to any type of vehicle lighter than 3.5 tonnes.

2.3. Results of the targeted consultation

2.3.1. Interviews

In order to obtain better insight and more detailed information, a set of targeted interviews have been carried out. Contributions were received from 21 different stakeholders, including nine Member States (four EU-15 and five EU-13), five transport companies, including two SMEs, four EU level representative bodies, two tolling companies and one national industry association. Stakeholders were asked questions on the potential policy options for amending the Directive.

Most of the nine **Member States** supported action to **incentivise the use of fuel efficient vehicles** in general, but not all of these were convinced of the ease and value of implementing this through CO_2-differentiated charges. The Member States that were most

supportive of CO_2-based charges underlined that it needed to be applied simply and that a system of differentiation according to CO_2 emissions needed to be phased-in carefully as the Euro emissions class system was phased out. Where they expressed a view, Member States wanted CO_2-based charging to be voluntary.

Of those Member States that expressed an opinion, one stated that a CO_2-based charge should be revenue-neutral, while another argued that it should not, as ensuring revenue-neutral differentiation requires regular changes to the charges, which posed administrative challenges and was difficult to communicate to industry. Opinion was also divided on the challenges and costs of changing to a CO_2-based system, as one Member State noted that their existing toll system could be relatively easily adapted for CO_2-based charges, while others noted that the administrative burden was potentially the main issue, as verifying the appropriate CO_2 emissions could be high, at least in the transition period.

One Member State felt that there were still benefits to be gained from being able to differentiate charges according to Euro emissions class, which could be lost if CO_2-based charging, for which there was still a lack of data, was introduced. Another also supported retaining differentiation by Euro emissions class, as this was easier to identify for a vehicle.

Amongst the **other stakeholders**, there was generally broad support for the principal of CO_2-based charging, but in practice some issues were identified. Two of the four EU level stakeholder organisations explicitly supported charging based on the results that emerge from VECTO, which will be used to monitor and report CO_2 emissions from HDVs and for setting emission reduction targets for these vehicles. In spite of the fact that information from VECTO will not be available to be used for the purpose of charging until 2020, these stakeholders underlined that the current Eurovignette amendment should enable the use of the VECTO's information as it becomes available, and then possibly phase out the use of Euro emissions classes. Other EU level stakeholders noted that the results of VECTO would not be accurate in practice, as the CO_2 emissions of an HDV in use depended on lot of factors. In spite of this, one noted that a vehicle that performs well "in the laboratory" would also perform well on the road, so that VECTO's results would be a good proxy for real-world emissions. The two EU level stakeholders that expressed an opinion stated that such differentiated charging should be applied to all vehicles.

The representatives of **transport companies** were supportive of taking account of transport's CO_2 emissions. One argued that it would be better to do this through fuel taxes, but as this was politically difficult, an approach based on the results of VECTO would be appropriate. Another supported CO_2-differentiated charges, as long as this was mandatory for all vehicles, including light duty vehicles. A third thought that reaching an agreement on CO_2-based charges would be politically-difficult and lacked a clear rationale compared to internalising the external costs of CO_2, so instead was in favour of the latter being mandatory. The transport companies underlined that the way in which differentiated-charging was implemented was of fundamental importance. A national **industry association** underlined that any system should be simple and sufficiently reward hauliers that use fuel-efficient vehicles.

The two representatives of **transport SMEs** that were interviewed were both generally supportive of the CO_2 differentiation of charges, but both underlined that it would be better if the same system was implemented and enforced in all Member States, otherwise there would be impacts on competitiveness.

The representatives of **tolling companies** were less supportive of CO_2-diferentiated charging, even though generally they supported measures to improve the environmental performance of transport. One was concerned that any changes to the structure of tolls

always opened up wider discussions of contracts, which potentially led to problems. They argued that it would contractually **simpler for CO_2-differentiated charges to be revenue-neutral**, i.e. reduce charges for new vehicles while increasing charges for older vehicles, although it would be relatively easy to do this using an electronic charging system. They also noted that more charging was the obvious way of replacing fuel tax revenues, which were likely to decline. The other tolling company was concerned that CO_2-based charging would have an adverse effect on its business model and that it risked complicating tolling, as it would be more complex than differentiating charges according to Euro emissions classes.

Member States were generally not supportive of the policy options that might be implemented to **enhance the quality of road infrastructure**. With respect to existing tolled roads, it was underlined that in countries that have a lot of tolled roads already, such as Austria, Italy and Slovenia, the concessionaries already have performance indicators written into their contracts or agreements, which include inter alia maintaining the quality of their road network. In Member States that do not have extensive charging networks, **indicators** are sometimes used to monitor road quality and to prioritise investment. Concerns were raised that it would be difficult to agree a common set of indicators, as those relevant to Alpine countries would be different to those needed in relatively flat countries. Additionally, a standard set of EU-wide indicators could be difficult for some countries to achieve, as a result of a lower levels of resources. One Member State suggested that the Directive could include a general requirements to establish indicators, but leave it to Member States to decide what these should be, while another saw the value of common indicators, but did not want these to be imposed. Another Member State supported the establishment of EU performance indicators for infrastructure maintenance, but thought that these should not be implemented through the Eurovignette Directive.

Subsidiarity concerns were raised in many cases, with Member States suggesting that it should be up to them to decide how to manage and fund their respective road networks in light of other priorities, and to decide on what they should report. A concern was also raised that the policy options proposed were more administrative in nature and so would introduce administrative costs without necessarily delivering better roads. Three Member States noted that in their countries revenues from charges were earmarked for road development and maintenance, and one of these suggested that such **earmarking** could be a requirement more generally.

Other stakeholders were more supportive of action to ensure the quality of the road network, although many underlined that it was important to make a distinction between tolled and non-tolled roads. In general, it was considered that tolled roads were reasonably well maintained, although there was still support for a more common approach, particularly on the TEN-T network. Several stakeholders supported the development of a **common set of indicators**, although many also recognised the associated challenges of achieving this. To overcome this, an EU level trade association proposed having a common road quality monitoring system that could be used across the EU with a central authority. Some supported the use of a common set of indicators together with the development by Member States of **national maintenance and upgrading plans**. Other options proposed included the development of guidelines on the minimum level of maintenance, although the details should be left to individual countries, and a requirement to take action to remedy any issues identified by any indicators.

A number of interviewees noted that distance-based charging was a potential solution to the problem of funding non-tolled roads, while several explicitly supported the earmarking of revenues from such charges for road maintenance and development.

With respect to **vignettes**, Member States were split on the need for further measures to **avoid discrimination**, but there was little support for phasing out vignettes. There was some support for expanding the existing proportionality rules that applied to HGVs to other vehicles such as cars and buses, although others opposed this arguing that the focus of the Eurovignette Directive should remain HGVs as these were the main type of vehicles that travelled a lot internationally. One Member State argued that if it was considered that vignettes did not sufficiently cover costs, the response should not be to abolish vignettes, but to lift the restrictions on them as it was not currently possible to use these to cover the costs imposed by HGVs. Some Member States believed that there was no need for additional rules, as it was more a case of properly enforcing existing rules on **proportionality**, rather than creating additional legislation. Those Member States that already had a distance-based charging scheme in place for HGVs often did not object to phasing out vignettes for HGVs. Several Member States argued that, particularly **for LDVs**, the costs of implementing a distance-based charging scheme were prohibitive, whereas a time-based system could deliver similar results for much less in the way of costs, even though it was not the best way of implementing the user-pays principle. One Member State argued that some countries, if faced with a choice between a distance-based system and no charging would adopt the latter approach, and so phasing out vignettes could lead to less charging overall.

With respect to distance-based charging, **Member States** were again divided on the need for additional measures to **ensure a level playing field**, with one questioning the logic behind the need for action in the first place. Some Member States that already had – or were planning – a distance-based charging scheme in place for HGVs supported this being made mandatory on the TEN-T network and extended to LCVs, but noted that this might be a challenge in other countries. One Member State supported the extension of the road charging rules to all vehicles, including **cars**, as this would increase acceptability amongst road hauliers, while another supported an extension to buses and coaches. Other Member States were explicitly against mandatory distance-based charging for any vehicles or even a common approach to such charging, arguing that vignettes were more appropriate in some cases (see above). It was also pointed out that in those countries with lower levels of traffic, revenues from distance-based charging would be less, which would further undermine the benefits of the scheme.

The majority of **other stakeholders** were in favour of distance-based charging applying to all vehicles and the phasing out of vignettes, although some supported vignettes for reasons similar to the Member States. The arguments in favour of distance-based charging included that this was fairer and better applied the user- and polluter-pays principles. Many of the stakeholders supported mandatory distance-based charging, at least as the ultimate long-term goal, and noted that this needed to be phased in gradually. One stakeholder proposed that after HGVs, it would be most appropriate to apply distance-based charging to buses and coaches, followed by LCVs, as these were being used in some Member States instead of heavier commercial vehicles as their use is less regulated. A number of stakeholders noted that distance-based charging was the obvious way for Member States to maintain revenue levels from road transport, with the likely decline of revenues from fuel duties in light of the increasing electrification and improved efficiency of the new vehicle fleet.

Many stakeholders also stressed that any increase in costs as a result of increased charges should be compensated for by reductions in other transport-related taxes. Those that were in favour of retaining the possibility of maintaining a vignette system noted that the increased costs for short-term users were justifiable as a result of the flexibility that the system provides to these users, and that the costs of introducing distance-based charging for cars in particular would be prohibitive. An **EU trade association** that supported

distance-based charging argued that in the short-term the proportionality requirements on vignettes should be retained; a **transport company** supported such rules being applied to all vehicles.

Member States generally favoured more flexibility in the Directive to enable them to **ensure an efficient transport system**, rather than more prescriptive requirements. Several Member States argued that the current approach to external cost charging needed to be simplified and that restrictions on the ability to increase charges by the time of day should be lifted in order to give Member States more flexibility. One Member State argued that the maximum level of any charge should be fixed to ensure consistency between Member States. It was proposed that rather than the Directive setting more rules to govern charges, it would be simpler if Member States simply had to justify their actions. In relation to **congestion charging**, some argued that it was a very local issue so the Directive should provide sufficient scope to allow for appropriate local action. In relation to **external cost charging** more generally, it was noted that in countries with older vehicle fleets, introducing such charging could be expensive for users. A general comment was that the more restrictions that were imposed on charging by the Directive, the less likely it was that a Member State would voluntarily implement a charging scheme, in spite of its potential benefits.

Views on whether the Directive should apply to **all vehicles** were divided, with some not supporting any extension to vehicles of less than 3.5 tonnes, while others supported non-mandatory principles being applied more generally.

Of the **other stakeholders** interviewed, **many transport companies supported congestion charging**, as long as it was mandatory and applied to **all vehicles**, while others were not convinced of the need for congestion charging. A mandatory scheme was preferred, as it was considered that if the choice was left to Member States, they might take the easier option politically and only apply congestion charges to HGVs rather than to all vehicles. One stakeholder noted that it was important for the Directive to be seen to facilitate congestion charging, so this should be explicit and congestion should be included as one of the external costs that could be covered by user charges, although Member States should be left with flexibility as to how to apply the charge. The need for a common methodology for applying the charges allowed by the Eurovignette Directive was mentioned by a couple of stakeholders.

Others opposed allowing Member States to charge for congestion, arguing that the costs of congestion were already internalised by hauliers in terms of increased fuel, labour and vehicle costs. Others believed that for inter-urban roads, the provisions of the Eurovignette Directive were already sufficient to enable Member States to address congestion, or that there would be no need for congestion charging if distance-based charging was introduced. Those that expressed a view on the use of revenues, argued that these should be used for new transport infrastructure and abatement measures. A couple of stakeholders believed that the decision as to whether to implement external costs charging generally, and congestion charging specifically, should be left to Member States and cities. Few stakeholders had any views on **potential adverse or beneficial impacts on SMEs**. The main observation was that anything that increased costs or complexity had the potential to have an adverse impact.

2.4. Results of the stakeholder seminars and conference

In the context of the planned road transport initiatives, as described in the Commission Work Programme 2016[3], DG MOVE organised a series of five informal seminars during September and October 2015. In addition a conference was held in April 2016.

2.4.1. Insufficient financing

Member States were generally of the opinion that flexibility is required to spend revenues from road charging according to national priorities and according to national decisions. Others echoed that it is important to respect subsidiarity in the area of infrastructure and maintenance financing. Stakeholders on the other hand, and particularly **road users**, stressed that earmarking of revenues and proper maintenance is a prerequisite for acceptability of user charges. It was also stressed that user charges and earmarking should be seen in a wider context of providing users with incentives to encourage improved economic and environmental performance of the road transport sector.

2.4.2. Vignettes

Some **Member States** advocated phasing out vignettes and replacing these with distance-based tolls collected with the help of interoperable on-board units. Several other Member States, however, thought that the flexibility of the current Eurovignette framework should be maintained, at least in the short to medium term. A positive aspect of vignettes was considered to be its relative simplicity and low administrative costs, in particular in countries having low volumes of transit traffic. Views were divided as to whether the issue of discrimination of passenger cars should be addressed by an extension of the Eurovignette framework. A **slight majority were in favour of including passenger cars** while others were against in order not to increase the cost burden.

2.4.3. Price signals

Whilst **most Member States expressed their support for the application of the user and polluter pays principles**, only some requested measures to ensure clearer and more effective price signals. For instance, some Member States currently charging for external costs, or planning to do so, proposed to review caps currently imposed on external cost charges. It was also proposed by some to allow a **differentiation of user charges and tolls based on CO2** emissions to better reflect the environmental performance of vehicles. Views were divided on the possibility to allow Member States to charge for **congestion** as an additional charge rather than, as presently, a variation of user charges and tolls. Whilst some Member States were in favour, others did not consider that a congestion charge would impact behaviour given that international hauliers are unable to avoid main congestion centres at some stage of their international journey. As a consequence, it was considered by some that a congestion charge may add costs and not significantly contribute to reducing congestion. **Stakeholders confirmed that clear and consistent price signals were important** given the highly competitive nature of the road haulage sector. It was noted that recent evidence (Germany was cited) has demonstrated that clear price signals have contributed to reducing empty running and to the use of more environmentally friendly trucks.

[3] COM(2015)610 final.

2.5. Conclusions and use of the results

There were some differences of note with respect to the responses from the different elements of the consultation.

There was general support for measures to **incentivise the use of fuel efficient vehicles**, although less specific support for doing this through charges and phasing out the possibility of differentiating charges by a vehicle's Euro emissions class. Some additional contributions and many non-Member State interviewees supported the introduction of CO_2-based differentiation and the phasing out of differentiation by Euro emissions class, whereas Member State interviewees were generally less supportive of this approach. While doubts have been expressed regarding its short-term feasibility, there was no obvious opposition to the revenue-neutral differentiation of charges based on CO_2 emissions.

In relation to possible measures to **ensure the quality of road infrastructure**, there was a distinct difference between, on the one hand, the views expressed in the online public consultation and the views of most stakeholders interviewed, and on the other, the views of the Member States interviewed. The majority of respondents to the public consultation and other interviewed stakeholders generally supported the measures to ensure the quality of road infrastructure. On the other hand, Member States were generally not supportive of the measures, citing subsidiarity concerns, that the proposals were unnecessary as tolled roads were already of sufficient quality and the challenges with identifying a common set of indicators.

With respect to possible measures to **avoid discrimination and ensure a level playing field**, there is again a distinct difference between the views of Member States and others. Respondents to the online public consultation strongly supported the application of the user-pays and polluter-pays principles, and for the EU to ensure that vignette prices are set proportionately. Many additional contributions and non-Member State interviewees supported the phasing out of vignettes and the introduction of distance-based charging. On the other hand, Member State interviewees were divided on the need for further action in this respect, they generally did not support the phasing out of vignettes (particularly for cars) and tended to support distance-based charging only if they already had such a system in place. Many argued – as did some other interviewees – that vignettes were more appropriate and cheaper for cars.

With respect to **ensuring an efficient transport system**, the majority of respondents to the online public consultation believed that dealing with congestion should be left to Member States, with the most popular option for congestion charging being that it should apply to all vehicles. The need for any congestion charging to cover all vehicles, not just HGVs, was underlined by those non-Member State interviewees who supported congestion charging. Member State interviewees were in general in favour of more flexibility about implementing the measures to ensure an efficient transport system.

The results of all the consultation activities were used in designing the policy options and selecting the measures. The most rejected ones were discarded after the initial screening and the retained measures were grouped options with increasing level of regulatory intervention, so that decision makers have the possibility to judge on the desired level of ambition. The results of the consultation are referred to throughout the various sections of the impact assessment.

3. ANNEX 3. WHO IS AFFECTED BY THE INITIATIVE AND HOW

Type of stakeholder	Practical implications
Road hauliers and logistics companies – many of which SMEs	Transport and operating costs Direct costs in the form of road charges may slightly increase for the average haulier (SME), with a possibility to make savings on road charge and fuel cost by using the cleanest and most efficient vehicles. All hauliers will benefit form of increased reliability and speed of deliveries from lower congestion and better road quality implying savings on vehicle operating cost and delay costs, which would offset any increase in road charge. In addition, hauliers will probably be compensated through reduced taxes (as it was the case most recently in Belgium where vehicle taxes were reduced to the minimum when the distance-based charge was introduced). Firms can react in different ways to the introduction of new road tolls, external cost charges and congestion charges: instead of absorbing them, SMEs are likely to pass on these costs to their customers; or they can reduce the impact on operating costs by adapting their operations to the new circumstances through route shift, travel time shift, frequency reduction, modal shift, or increased uptake of low/zero emission vehicles. Firms investing in low/zero emission vehicles will benefit from lower fuel/running costs that are expected to more than compensate for increased purchase prices over the lifetime of the vehicles.
Shippers & consumers	Transport costs/prices Shippers might be required to adapt their shipping practices to slightly modified transport prices (depending on the itinerary), but would benefit from more efficient transport operations, reduced delays, more predictable delivery times. This is especially important to firms working for sectors such as manufacturing and retail (where there is high reliance on just-in-time delivery). Impacts on consumer prices are expected to be negligible, even under cases of 100% cost pass-through.
Private road users	Cost of mobility & behaviour Regular users of toll roads would experience hardly any difference in road charge on average but, like hauliers, would benefit from better road conditions and reduced congestion. Occasional road users would benefit from fairer treatment (lower charges) in Member States with time-based charging. Those travelling regularly alone by car in rush-hour on roads with distance-based charging may – only in case the Member State decides to introduce time-differentiated charging – either be

	required to change habits and/or transport mode, or would face higher road charges and be the main beneficiaries of reduced congestion in exchange. The exact level of road charge will depend on the specific local context; however, as an example, a trip with 10 km in near capacity condition (7 km on rural and 3 km on metropolitan motorway) may be charged up to 1-2 euro – a price very much comparable to an equivalent trip by train or bus. Indeed it would be possible to mitigate even this small cost by carpooling. Depending on the itinerary, the cost of long distance travel by bus may slightly increase (around 1 euro per passenger on a trip involving 400 km of motorways), which will be considered by the travellers when choosing between different transport modes, e.g. bus or train.
Road operators	<u>Revenues & budget</u> Assuming that a significant portion of collected tolls would be allocated to the operator of the toll road, they would dispose of a stable revenue stream to maintain their road network in good/safe condition. This would make it possible for road operators to time their maintenance activities in an optimal way thereby reducing long-term maintenance costs. <u>Monitoring & reporting</u> Those operators, which have no regular road quality monitoring in place, would be required to implement such a scheme; they may need to consult other operators for the purpose of exchanging good practices and capacity building, and would be required to report on the results on a yearly basis. The costs associated with these obligations would be covered by toll revenues (the inclusion of such costs in the calculation of tolls is already provided for in the Directive).
Member States' administrations	<u>Investment & budget</u> Those Member States, which currently apply vignettes for HDVs would have to choose between two possibilities if they want to replace revenues forgone due to the abolishing the scheme: (1) introduce distance-based charging within 5 years if they intend to collect user charges on their roads; alternatively, (2) they may choose to raise the equivalent amount of revenues via other channels, e.g. by slightly increasing transport taxes (fuel or vehicle). All other Member States would also be affected by additional costs where they introduce new road tolls (voluntarily). 1. Increasing fuel tax could be a meaningful alternative as it is paid in proportion of fuel burnt and in principle by all road users. It is very easy to implement at virtually no cost. For example, in the case of Luxembourg, the revenues forgone

	thanks to abolishing the Eurovignette system could be compensated by less than 2% increase in fuel tax. However, increasing fuel taxes can be politically difficult in some countries, and many Member States are seeking alternative sources of revenue as vehicles become more fuel efficient (eroding the tax base). 2. Road charging provides a more direct price signal to the user, whereas the fuel price, once paid, is already a sunk cost. Distance-based road charging can also be adjusted according to the environmental performance of vehicles, noise levels and time of day, thereby contributing to reducing external costs. Steady revenues collected from the users can ensure a quick payback period (generally within the same year), and long-term benefits in any case. Furthermore, the cost of operating different electronic toll schemes varies between 4.5 and 12% of toll revenues. The cost of on-board units is on a downward path. [4] For Member States choosing to introduce new road tolls, this result in an initial investment cost of around €150m (€82m to €232m, depending on the size of the county) and ongoing maintenance/enforcement costs of around €20m per year (€9m to €41m). At the same time, it is also possible to introduce electronic tolling at lower cost as in Hungary (below EUR 100 million). These costs would be counterbalanced by increased revenues from road user charges in all cases, which would be greater than the ongoing costs. <u>Reporting</u> There may be small additional costs for implementing the measures regarding monitoring and reporting of investments, expenditures and road quality (although several Member States already do this), but these would be very minor, especially in comparison to the system costs explained above.
Equipment manufacturers	Wider application of distance-based road charging will mean more business opportunities for electronic toll service providers, while the competitiveness of OEMs will be positively affected by increased demand for cleaner and more efficient vehicles.
Society at large	Society and the economy would benefit from the wider application of proportionate distance-based road pricing (i.e. the polluter pays and user pays principles), since it will incentivise more efficient transport operations, the use of cleaner vehicles and ultimately result in lesser negative impact from transport, lower level of externalities, including reduced CO_2 emissions.

[4] Ex-post evaluation of Directive 2004/52/EC on the interoperability of electronic road toll systems in the Community and Commission Decision 2009/750/EC on the definition of the European Electronic Toll Service and its technical elements

4. ANNEX 4. ANALYTICAL MODELS USED IN PREPARING THE IMPACT ASSESSMENT

4.1. Description of analytical models used

A model suite has been used for the analytical work, combining the strengths of three different models: ASTRA, PRIMES-TREMOVE and TRUST. The model suite covers the entire transport system (e.g. transport activity represented at Member State level, by origin-destination and at link level, technologies and fuels at Member State level, air pollution emissions at Member State and link level and CO_2 emissions at Member State level) and its macro-economic impacts:

- **Geography:** individually all EU Member States.
- **Time horizon:** 2005 to 2050 (5-year time steps) in PRIMES-TREMOVE. ASTRA has been run up to 2030 for this impact assessment.
- **Transport modes covered:** private road passenger (cars, powered 2 wheelers), public road passenger (buses and coaches), road freight (heavy goods vehicles, light commercial vehicles), passenger rail, freight rail, passenger aviation, freight and passenger inland navigation and short sea shipping. Numerous classes of vehicles and transport means with tracking of technology vintages.
- **Regions/road types:** traffic represented at country level in PRIMES-TREMOVE[5]; by origin at NUTS 2 level in ASTRA and at link level by NUTS 3 region in TRUST.
- **Energy:** all crude oil derived fuels, biofuels, CNG, LNG, LPG, electricity and hydrogen (PRIMES-TREMOVE[6] and ASTRA).
- **Emissions:** greenhouse gas emissions and pollutants emissions (CO, NOx, PM2.5), and VOC (ASTRA).
- **Stock of vehicles:** full dynamics of stock turnover for road (more refined) and non-road transport means.
- **Macro-economic impacts:** GDP and employment (ASTRA).

A brief description of each model is provided below, followed by an explanation of each model's role in the context of this impact assessment.

4.1.1. ASTRA model

ASTRA (ASsessment of TRAnsport Strategies) is an integrated assessment model using a system dynamics approach[7,8]. It projects and evaluates the impacts of policy measures on GDP, employment, transport demand performance by mode for passenger and freight, vehicle fleet composition and transport emissions at country level for each EU Member State. Transport demand is generated for passenger and freight at NUTS 2 level.

The model includes four main components: economy, transport, technology and environment. The macro-economic component consists of five elements: supply side, demand side (including an investment module), an input-output model based on 25

[5] For trip classes distinction between urban areas (distinguished into one metropolitan and other urban areas) and inter-urban areas (distinguished into motorways and other roads).

[6] PRIMES-TREMOVE additionally provides for the linkage to refuelling/recharging infrastructure by trip type.

[7] Source: http://www.astra-model.eu/index.htm

[8] Source: http://www.assist-project.eu/assist-project-en/content/deliverables.php

economic sectors, employment module and government module. In addition, two trade models are implemented (i.e. intra-EU trade and EU to rest-of-the-world trade). The transport component is represented by means of two classical 4-stage transport models, one for passenger and one for freight transport, including endogenous feedback on all stages[9]. The transport network is not explicitly represented but information on network capacity is considered for the different transport modes drawing on the TRUST model. The technology component covers the differentiation of road vehicle fleets into age classes and different emission standard categories[10,11]. Investments and learning curves are included in the simulation of the fleet development process. Efficiency improvements are also included for non-road modes. The environment component calculates the emissions from transport based on traffic flows, the information on the composition of the vehicle fleets and on emission factors. ASTRA quantifies the impacts on fuel consumption, CO_2 emissions and air pollutants (NOx, PM, CO and VOC).

ASTRA allows quantifying the impact of policies in the field of pricing (e.g. road charging schemes for light duty and heavy duty vehicles, railways infrastructure charges), taxation (e.g. energy taxation, vehicle taxation, feebates), infrastructure (e.g. TEN-T projects accelerated implementation, improving frequency and reliability of service), internal market (e.g. opening of the domestic rail passenger market, elimination of restrictions on cabotage, simplification of formalities for ships travelling between EU ports), efficiency standards (e.g. CO_2 emissions standards for light duty and heavy duty vehicles, standards for controlling air pollution), transport planning (e.g. city logistics/urban freight distribution/urban consolidation centres) and research and innovation (e.g. increased replacement rate of inefficient and polluting vehicles, electromobility).

ASTRA has been recently used for a study on the deployment of C-ITS in Europe[12], for a study on the cost of non-completion of the TEN-T[13] and for a 2013 study on the Eurovignette Directive, and in a series of Horizon 2020 and FP7 research projects like: REFLEX, FUTRE, ASSIST, GHG-TransPoRD[14].

ASTRA is a private model, developed and maintained by TRT, MFIVE and Fraunhofer-ISI[15]. A version of ASTRA, so-called ASTRA-EC, is available to external users through a user interface[16].

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[9] Even if a full origin-destination matrix is not modelled, demand is segmented according to trip purpose and in different distance bands to better consider the competition between alternative modes.

[10] Road freight transport demand is segmented by different vehicle types: light commercial vehicles (below 3.5 tonnes), medium heavy goods vehicles (from 3.5 to 12 tonnes) and large heavy goods vehicles (above 12 tonnes) - according to different spatial domains (i.e. local, short, national, international). Assumptions on the composition of vehicle fleet used in each spatial domain are made to reflect the use of each vehicle type. The demand for new heavy goods vehicles as well as the replaced vehicles is associated with emission standards depending on the year of registration but the model only covers conventional diesel technologies. Nevertheless, the version of the model used for the IA includes also differentiation by fuel technology, based on the input of the PRIMES-TREMOVE model. For cars, the model differentiates the engine types, including e.g. hybrid, electric and fuel cells.

[11] See Annex A of Ricardo et al. (2017) Support Study for the Impact Assessment Accompanying the Revision of Directive 1999/62/EC.

[12] Source: http://ec.europa.eu/transport/sites/transport/files/2016-c-its-deployment-study-final-report.pdf

[13] Source : http://ec.europa.eu/transport/sites/transport/files/themes/infrastructure/studies/doc/2015-06-fraunhofer-cost-of-non-completion-of-the-ten-t.pdf

[14] Source: http://www.astra-model.eu/downloads-research-applications.htm

[15] Source: http://www.astra-model.eu/index.htm

[16] Source: http://www.assist-project.eu/assist-project-en/content/deliverables.php

4.1.2. PRIMES-TREMOVE transport model

The PRIMES-TREMOVE transport model projects the evolution of demand for passengers and freight transport by transport mode and transport mean. It is essentially a dynamic system of multi-agent choices under several constraints, which are not necessarily binding simultaneously. The model consists of two main modules, the transport demand allocation module and the technology choice and equipment operation module. The two modules interact with each other and are solved simultaneously.

The projections include details for a large number of transport means, technologies and fuels, including conventional and alternative types, and their penetration in various transport market segments for each EU Member State. They also include details about greenhouse gas and air pollution emissions (e.g. NOx, PM, SOx, CO), as well as impacts on external costs of congestion, noise and accidents.

In the transport field, PRIMES-TREMOVE is suitable for modelling soft measures (e.g. eco-driving, deployment of Intelligent Transport Systems, labelling), economic measures (e.g. subsidies and taxes on fuels, vehicles, emissions; ETS for transport when linked with PRIMES; pricing of congestion and other externalities such as air pollution, accidents and noise; measures supporting R&D), regulatory measures (e.g. CO_2 emission performance standards for new passenger cars and new light commercial vehicles; EURO standards on road transport vehicles; technology standards for non-road transport technologies), infrastructure policies for alternative fuels (e.g. deployment of refuelling/recharging infrastructure for electricity, hydrogen, LNG, CNG). Used as a module which contributes to a broader PRIMES scenario, it can show how policies and trends in the field of transport contribute to economy wide trends in energy use and emissions. Using data disaggregated per Member State, it can show differentiated trends across Member States.

PRIMES-TREMOVE has been used for the 2011 White Paper on Transport, Low Carbon Economy and Energy 2050 Roadmaps, the 2030 policy framework for climate and energy and more recently for the Effort Sharing Regulation, the review of the Energy Efficiency Directive, the recast of the Renewables Energy Directive and for the European strategy on low-emission mobility.

The PRIMES-TREMOVE is a private model that has been developed and is maintained by E3MLab/ICCS of National Technical University of Athens[17], based on, but extending features of the open source TREMOVE model developed by the TREMOVE[18] modelling community. Part of the model (e.g. the utility nested tree) was built following the TREMOVE model[19]. Other parts, like the component on fuel consumption and emissions, follow the COPERT model.

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[17] Source: http://www.e3mlab.National Technical University of Athens.gr/e3mlab/

[18] Source: http://www.tmleuven.be/methode/tremove/home.htm

[19] Several model enhancements were made compared to the standard TREMOVE model, as for example: for the number of vintages (allowing representation of the choice of second-hand cars); for the technology categories which include vehicle types using electricity from the grid and fuel cells. The model also incorporates additional fuel types, such as biofuels (when they differ from standard fossil fuel technologies), LPG and LNG. In addition, representation of infrastructure for refuelling and recharging are among the model refinements, influencing fuel choices. A major model enhancement concerns the inclusion of heterogeneity in the distance of stylised trips; the model considers that the trip distances follow a distribution function with different distances and frequencies. The inclusion of heterogeneity was found to be of significant influence in the choice of vehicle-fuels especially for vehicles-fuels with range limitations.

As module of the PRIMES energy system model, PRIMES-TREMOVE[20] has been successfully peer reviewed[21], most recently in 2011[22].

4.1.3. TRUST

TRUST (TRansport eUropean Simulation Tool) is a European scale transport network model covering road, rail and maritime transport[23]. TRUST covers the whole Europe and its neighbouring countries and allows for the assignment of origin-destination matrices at NUTS 3 level (about 1600 zones) for passenger and freight demand.

TRUST projects the average daily loads on road links split by demand segment and by country of origin, road traffic activity (passenger-km, tonnes-km, vehicle-km) per year by country (based on territoriality principle), origin-destination journey time, road accessibility measures by NUTS 3 region, energy consumption and emissions of NOx, PM, VOC, CO and CO_2 by link.

Road transport demand is modelled in TRUST by means of origin-destination matrices between NUTS 3 zones. Intra-NUTS 3 demand is not part of the matrices as it is not assigned to the network, but implicitly considered as pre-load on links. TRUST freight matrix includes tonnes transported by vehicles above 3.5 tonnes (i.e. heavy goods vehicles) and no differentiation of the matrix by heavy goods vehicle type is available. For this reason, the model works with an average charge (currently weighted on the composition of the vehicle fleet and on the charges by vehicle size and EURO classes, where applied). Average charges are applied to the road network as link-based tolls and are differentiated according to link types (e.g. motorway, roads with separate carriageways, two-lane roads) and at country level.

National vignettes are applied as equivalent distance fares (i.e. the fare of the yearly vignette is translated into a distance-base cost as ratio between the cost of the vignette and the average annual travelled mileage on the charged network). The links where extra-tolls are levied (e.g. tunnels, mark-ups etc.) are modelled case by case. Link tolls, together with other variable operating costs (fuel and, for trucks, driver costs) are relevant for path choice during the assignment step.

TRUST is particularly suitable for modelling road charging schemes for cars and heavy goods vehicles, and policies in the field of infrastructure (e.g. completion of the core and comprehensive TEN-T network).

TRUST is a private model, developed and maintained by TRT[24]. It has been used for the 2013 ex-post evaluation of transport infrastructure charging policy, for the TRACC -

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[20] The model can be run either as a stand-alone tool (e.g. for the 2011 White Paper on Transport and for the 2016 Strategy on low-emission mobility) or fully integrated in the rest of the PRIMES energy systems model (e.g. for the Low Carbon Economy and Energy 2050 Roadmaps, for the 2030 policy framework for climate and energy, for the Effort Sharing Regulation, for the review of the Energy Efficiency Directive and for the recast of the Renewables Energy Directive). When coupled with PRIMES, interaction with the energy sector is taken into account in an iterative way.

[21] Source: http://ec.europa.eu/clima/policies/strategies/analysis/models/docs/primes_model_2013-2014_en.pdf.

[22] https://ec.europa.eu/energy/sites/ener/files/documents/sec_2011_1569_2.pdf

[23] See Annex A of Ricardo et al. (2017) Support Study for the Impact Assessment Accompanying the Revision of Directive 1999/62/EC.

[24] Source : http://www.trt.it/en/tools/trust/

TRansport ACCessibility at regional/local scale and patterns in Europe[25] and for other TEN-T projects focusing on e.g. improving the ports and multimodal transport links of the northern Adriatic[26].

4.1.4. ASTRA, PRIMES-TREMOVE and TRUST role in the impact assessment

PRIMES-TREMOVE transport model is a building block of the modelling framework used for developing the EU Reference scenario 2016, and has a successful record of use in the Commission's transport, climate and energy policy analytical work – it is the same model as used for the 2011 White Paper on Transport and the 2016 European strategy on low-emission mobility. In this impact assessment, it has been used to define the Baseline scenario, having as a starting point the EU Reference scenario 2016 but additionally including few policy measures that have been adopted after its cut-off date (end of 2014). In addition, the large number of transport means, technologies and fuels, including conventional and alternative types, and its ability to evaluate the impact of tolls on the vehicle fleet renewal (i.e. trend and composition), made PRIMES-TREMOVE particularly suitable for assessing the impacts of modulation of infrastructure charges according to CO_2 emissions.

TRUST model is a European scale transport network model that allows for the assignment of origin-destination matrices at NUTS 3 level for passenger and freight demand. As the transport network is not represented in either PRIMES-TREMOVE or ASTRA, TRUST was used for evaluating the impacts of road assignment on link-based indicators (e.g. traffic and NOx emissions at link level). At Member State level, the Baseline trend of road transport activity has been estimated on the trend of road transport demand in the ASTRA model, which is calibrated according to PRIMES-TREMOVE projections.

ASTRA has been used to quantify the impacts of policy options, taking the form of integrated policy packages, and to provide indicators for the direct effects on the transport system (e.g. transport activity, energy use, air pollutant and CO_2 emissions) and for the indirect effects of transport on the economic system (e.g. GDP, employment). The Baseline scenario has been calibrated on PRIMES-TREMOVE projections. For the modulation of the infrastructure charges according to CO_2 emissions, in the first stage the PRIMES-TREMOVE model has been run while in the second stage PRIMES-TREMOVE results (i.e. the structure of the vehicle fleet by type of powertrain, euro class and age and its evolution; increase in road charges for vehicles with CO_2 emissions above the average[27]) have been used in defining the integrated policy packages (i.e. policy options) in ASTRA. For each policy options, ASTRA provides the TRUST model with the average road charge by country (based on the new vehicle fleet composition) and with updated road demand growth rate by mode, country, Origin-Destination and spatial domain. For policy options

[25] http://www.espon.eu/main/Menu_Projects/Menu_ESPON2013Projects/Menu_AppliedResearch/tracc.html

[26] https://ec.europa.eu/inea/en/ten-t/ten-t-project-implementation-successes/improving-ports-and-multimodal-transport-links-northern

[27] The increase in road charges for the part of the vehicle fleet with CO_2 emissions above the average has been derived while respecting revenue-neutrality, i.e. while reducing charges for vehicles with lower than average CO_2 emissions.

including congestion charging, feedback loops from TRUST to ASTRA are implemented to take account of the impacts on the transport network[28].

4.2. Baseline scenario

4.2.1. Scenario design, consultation process and quality assurance

The Baseline scenario used in this impact assessment builds on the EU Reference scenario 2016 but additionally includes few policy measures adopted after its cut-off date (end of 2014) and some updates in the technology costs assumptions.

Building an EU Reference scenario is a regular exercise by the Commission. It is coordinated by DGs ENER, CLIMA and MOVE in association with the JRC, and the involvement of other services via a specific inter-service group.

For the EU Reference scenario 2016, Member States were consulted throughout the development process through a specific Reference scenario expert group which met three times during its development. Member States provided information about adopted national policies via a specific questionnaire, key assumptions have been discussed and in each modelling step, draft Member State specific results were sent for consultation. Comments of Member States were addressed to the extent possible, keeping in mind the need for overall comparability and consistency of the results.

Quality of modelling results was assured by using state of the art modelling tools, detailed checks of assumptions and results by the coordinating Commission services as well as by the country specific comments by Member States.

The EU Reference scenario 2016 projects EU and Member States energy, transport and GHG emission-related developments up to 2050, given current global and EU market trends and adopted EU and Member States' energy, transport, climate and related relevant policies. "Adopted policies" refer to those that have been cast in legislation in the EU or in MS (with a cut-off date end of 2014[29]). Therefore, the binding 2020 targets are assumed to be reached in the projection. This concerns greenhouse gas emission reduction targets as well as renewables targets, including renewables energy in transport. The EU Reference scenario 2016 provides projections, not forecasts. Unlike forecasts, projections do not make predictions about what the future will be. They rather indicate what would happen if the assumptions which underpin the projection actually occur. Still, the scenario allows for a consistent approach in the assessment of energy and climate trends across the EU and its Member States.

The report " EU Reference Scenario 2016: Energy, transport and GHG emissions - Trends to 2050"[30] describes the inputs and results in detail. In addition, its main messages are summarised in the impact assessments accompanying the Effort Sharing Regulation[31] and

[28] See Annex A of Ricardo et al. (2017) Support Study for the Impact Assessment Accompanying the Revision of Directive 1999/62/EC.

[29] In addition, amendments to two Directives only adopted in the beginning of 2015 were also considered. This concerns notably the ILUC amendment to the Renewables Directive and the Market Stability Reserve Decision amending the ETS Directive.

[30] ICCS-E3MLab et al. (2016), EU Reference Scenario 2016: Energy, transport and GHG emissions - Trends to 2050

[31] SWD(2016) 247

the revision of the Energy Efficiency Directive[32], and the analytical work accompanying the European strategy on low-emission mobility[33].

PRIMES-TREMOVE is one of the core models of the modelling framework used for developing the EU Reference scenario 2016 and has also been used for developing the Baseline scenario of this impact assessment. The model was calibrated on transport and energy data up to year 2013 from Eurostat and other sources.

4.2.2. Main assumptions of the Baseline scenario

The projections are based on a set of assumptions, including on population growth, macroeconomic and oil price developments, technology improvements, and policies.

Macroeconomic assumptions

The Baseline scenario uses the same macroeconomic assumptions as the EU Reference scenario 2016. The population projections draw on the European Population Projections (EUROPOP 2013) by Eurostat. The key drivers for demographic change are: higher life expectancy, convergence in the fertility rates across Member States in the long term, and inward migration. The EU28 population is expected to grow by 0.2% per year during 2010-2030 (0.1% for 2010-2050), to 516 million in 2030 (522 million by 2050). Elderly people, aged 65 or more, would account for 24% of the total population by 2030 (28% by 2050) as opposed to 18% today.

GDP projections mirror the joint work of DG ECFIN and the Economic Policy Committee, presented in the 2015 Ageing Report[34]. The average EU GDP growth rate is projected to remain relatively low at 1.2% per year for 2010-2020, down from 1.9% per year during 1995-2010. In the medium to long term, higher expected growth rates (1.4% per year for 2020-2030 and 1.5% per year for 2030-2050) are taking account of the catching up potential of countries with relatively low GDP per capita, assuming convergence to a total factor productivity growth rate of 1% in the long run.

Fossil fuel price assumptions

Oil prices used in the Baseline scenario are the same with those of the EU Reference scenario 2016. Following a gradual adjustment process with reduced investments in upstream productive capacities by non-OPEC[35] countries, the quota discipline is assumed to gradually improve among OPEC members and thus the oil price is projected to reach 87 $/barrel in 2020 (in year 2013-prices). Beyond 2020, as a result of persistent demand growth in non-OECD countries driven by economic growth and the increasing number of passenger cars, oil price would rise to 113 $/barrel by 2030 and 130 $/barrel by 2050.

No specific sensitivities were prepared with respect to oil price developments. Still, it can be recalled that lower oil price assumptions tend to increase energy consumption and CO_2 emissions not covered by the ETS. The magnitude of the change would depend on the price elasticities and on the share of taxation, like excise duties, in consumer prices. For transport, the high share of excise duties in the consumer prices act as a limiting factor for the increase in energy consumption and CO_2 emissions.

Techno-economic assumptions

[32] SWD(2016) 405
[33] SWD(2016) 244
[34] European Commission/DG ECFIN (2014), The 2015 Ageing Report: Underlying Assumptions and Projection Methodologies, European Economy 8/2014.
[35] OPEC stands for Organization of Petroleum Exporting Countries.

For all transport means, except for light duty vehicles (i.e. passenger cars and light commercial vehicles), the Baseline scenario uses the same technology costs assumptions as the EU Reference scenario 2016.

For light duty vehicles, the data for technology costs and emissions savings has been updated based on a recent study commissioned by DG CLIMA[36]. Battery costs for electric vehicles are assumed to go down to 205 euro/kWh by 2030 and 160 euro/kWh by 2050; further reductions in the cost of both spark ignition gasoline and compression ignition diesel are assumed to take place. Technology cost assumptions are based on extensive literature review, modelling and simulation, consultation with relevant stakeholders, and further assessment by the Joint Research Centre (JRC) of the European Commission.

Specific policy assumptions

The key policies included in the Baseline scenario, similarly to the EU Reference scenario 2016, are[37]:

- CO2 standards for cars and vans regulations (Regulation (EC) No 443/2009, amended by Regulation (EU) No 333/2014 and Regulation (EU) No 510/2011, amended by Regulation (EU) No 253/2014); CO2 standards for cars are assumed to be 95gCO2/km as of 2021 and for vans 147gCO2/km as of 2020, based on the NEDC test cycle, in line with current legislation. No policy action to strengthen the stringency of the target is assumed after 2020/2021.
- The Renewable Energy Directive (Directive 2009/28/EC) and Fuel Quality Directive (Directive 2009/30/EC) including ILUC amendment (Directive 2015/1513/EU): achievement of the legally binding RES target for 2020 (10% RES in transport target) for each Member State, taking into account the use of flexibility mechanisms when relevant as well as of the cap on the amount of food or feed based biofuels (7%). Member States' specific renewable energy policies for the heating and cooling sector are also reflected where relevant.
- Directive on the deployment of alternative fuels infrastructure (Directive 2014/94/EU).
- Directive on the charging of heavy goods vehicles for the use of certain infrastructures (Directive 2011/76/EU amending Directive 1999/62/EC).
- Relevant national policies, for instance on the promotion of renewable energy, on fuel and vehicle taxation, are taken into account.

In addition, a few policy measures adopted after the cut-off date of the EU Reference scenario 2016 at both EU and Member State level, have been included in the Baseline scenario:

- Directive on weights & dimensions (Directive 2015/719/EU);
- Directive as regards the opening of the market for domestic passenger transport services by rail and the governance of the railway infrastructure (Directive 2016/2370/EU);

[36] Source: https://ec.europa.eu/clima/sites/clima/files/transport/vehicles/docs/technology_results_web.xlsx

[37] For a comprehensive discussion see the Reference scenario report: "EU Reference Scenario 2016: Energy, transport and GHG emissions - Trends to 2050"

- Directive on technical requirements for inland waterway vessels (Directive 2016/1629/EU), part of the Naiades II package;
- Regulation establishing a framework on market access to port services and financial transparency of ports[38];
- The replacement of the New European Driving Cycle (NEDC) test cycle by the new Worldwide harmonized Light-vehicles Test Procedure (WLTP) has been implemented in the Baseline scenario, drawing on work by JRC. Estimates by JRC show a WLTP to NEDC CO_2 emissions ratio of approximately 1.21 when comparing the sales-weighted fleet-wide average CO_2 emissions. WLTP to NEDC conversion factors are considered by individual vehicle segments, representing different vehicle and technology categories[39].
- For Germany, an extension of the toll network by roughly 40,000 kilometres of federal trunk road from 2018 onwards for all heavy goods vehicles over 7.5t.[40]
- For Austria, the incorporation of exhaust emissions and noise pollution in the distance based charges. All federal highways and motorways, totalling around 2,200 km, are subject to distance based charges.
- For Belgium, a distance based system replaced the former Eurovignette for heavy goods vehicles over 3.5t from April 2016. The system applies to all inter-urban motorways, main (national) roads[41] and all urban roads in Brussels.
- For Latvia, the introduction of a vignette system applied for goods vehicles below 3.5t on the motorways, starting with 1 January 2017. In addition, for all heavy goods vehicles over 3.5t the vignette rates applied on motorways for the EURO 0, EURO I, EURO II are increased by 10% starting with 1 January 2017.

[38] Awaiting signature of act (Source : http://www.europarl.europa.eu/oeil/popups/ficheprocedure.do?reference=2013/0157(COD)&l=en)

[39] Simulation at individual vehicle level is combined with fleet composition data, retrieved from the official European CO_2 emissions monitoring database, and publicly available data regarding individual vehicle characteristics, in order to calculate vehicle CO_2 emissions and fuel consumption over different conditions. Vehicle CO_2 emissions are initially simulated over the present test protocol (NEDC) for the 2015 passenger car fleet; the accuracy of the method is validated against officially monitored CO_2 values and experimental data.

[40] Currently, 15,000 kilometres of federal trunk road and motorways are subject to tolls.

[41] E.g. http://www.viapass.be/fileadmin/viapass/documents/download/VlaanderenE.JPG

Figure 4-1: Summary of road charging systems applied by Member States in the Baseline

Current Situation			AT	BE	BG	CY	CZ	DE[42]	DK	EE	EL	ES	FI	FR	HR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Road infrastructure charge	Vignette	HGV <12t			■														■		■					■				
		HGV >12 t			■				■										■	■	■		■			■	■			■
		Buses			■											■			■		■					■				
		Vans	■		■		■									■			■		■					■		■	■	
		Cars	■		■		■									■										■		■	■	
	Toll	HGV <12t	■	■			■				■	■		■	■	■	■	■						■	■			■	■	
		HGV >12 t	■	■			■	■			■	■		■	■	■	■	■						■	■			■	■	
		Buses	■				■				■	■		■	■		■	■						■	■			■	■	
		Vans									■	■		■	■		■	■						■	■					
		Cars									■	■		■	■		■	■						■	■					
Phasing out vignette		HGV																												
		Buses																												
		Vans																												
		Cars																												
EURO Class modulation		HGV		■	■		■		■							■			■	■	■		■	■			■	■	■	
		Buses			■		■												■		■			■				■	■	
Phasing in CO2/pollutant modulation		HGV																												
		Buses																												
		Vans																												
		Cars																												
Rebates for zero emission vehicles		HGV																												
		Buses																												
		Vans																												
		Cars																												
External costs		HGV	■					■																						
		Buses	■																											
Congestion charging		All																												
Mark-ups		HGV	■																											
		Buses	■																											
Reduced circulation taxes		HGV																												

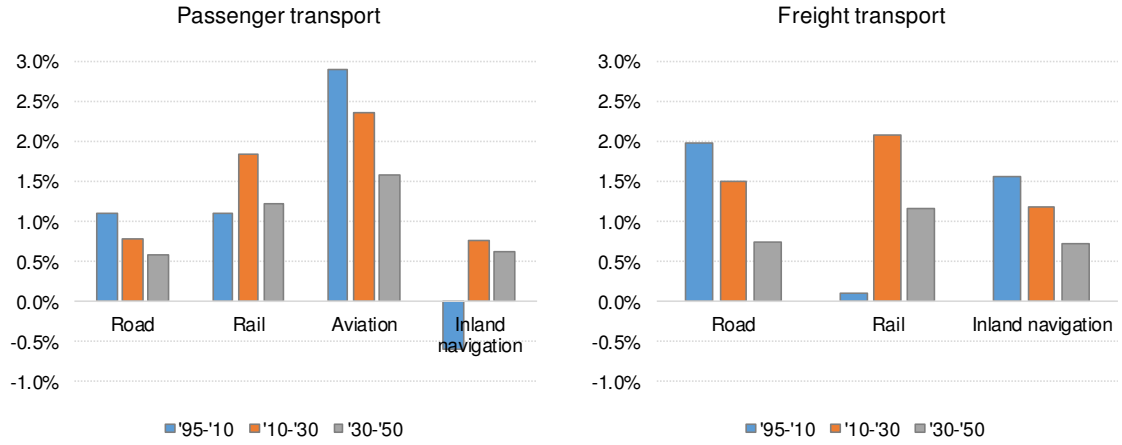
[42] In the Baseline only tolls for HGVs above 7.5 t apply.

4.2.3. Summary of main results of the Baseline scenario

EU transport activity is expected to continue growing under current trends and adopted policies beyond 2015, albeit at a slower pace than in the past. Freight transport activity for inland modes is projected to increase by 36% between 2010 and 2030 (1.5% per year) and 60% for 2010-2050 (1.2% per year). Passenger traffic growth would be slightly lower than for freight at 23% by 2030 (1% per year) and 42% by 2050 (0.9% per year for 2010-2050). The annual growth rates by mode, for passenger and freight transport, are provided in Figure 4-2[43].

Road transport would maintain its dominant role within the EU. The share of road transport in inland freight is expected to slightly decrease at 70% by 2030 and 69% by 2050. The activity of heavy goods vehicles expressed in tonnes kilometres is projected to grow by 35% between 2010 and 2030 (56% for 2010-2050) in the Baseline scenario, while light goods vehicles activity would go up by 27% during 2010-2030 (50% for 2010-2050). For passenger transport, road modal share is projected to decrease by 4 percentage points by 2030 and by additional 3 percentage points by 2050. Passenger cars and vans would still contribute 70% of passenger traffic by 2030 and about two thirds by 2050, despite growing at lower pace (17% for 2010-2030 and 31% during 2010-2050) relative to other modes, due to slowdown in car ownership increase which is close to saturation levels in many EU15 Member States and shifts towards rail.

Figure 4-2: Passenger and freight transport projections (average growth rate per year)



Source: Baseline scenario, PRIMES-TREMOVE transport model (ICCS-E3MLab)
Note: For aviation, domestic and international intra-EU activity is reported, to maintain the comparability with reported statistics.

Rail transport activity is projected to grow significantly faster than for road, driven in particular by the opening of the market for domestic passenger rail transport services and the effective implementation of the TEN-T guidelines, supported by the CEF funding, leading to the completion of the TEN-T core network by 2030 and of the comprehensive network by 2050. Passenger rail activity goes up by 44% between 2010 and 2030 (84% for 2010-2050), increasing its modal share by 1 percentage point by 2030 and an additional percentage point by 2050. Rail freight activity grows by 51% by 2030 and 90% during 2010-2050, resulting in 2 percentage points increase in modal share by 2030 and an additional percentage point by 2050.

[43] Projections for international maritime and international extra-EU aviation are presented separately and not included in the total passenger and freight transport activity to preserve comparability with statistics for the historical period.

Domestic and international intra-EU air transport would grow significantly (by 59% by 2030 and 118% by 2050) and increase its share in overall transport demand (by 3 percentage points by 2030 and by additional 2 percentage points by 2050). Overall, aviation activity including international extra-EU flights is projected to go up by 60% by 2030 and 124% by 2050, saturating European skies and airports.

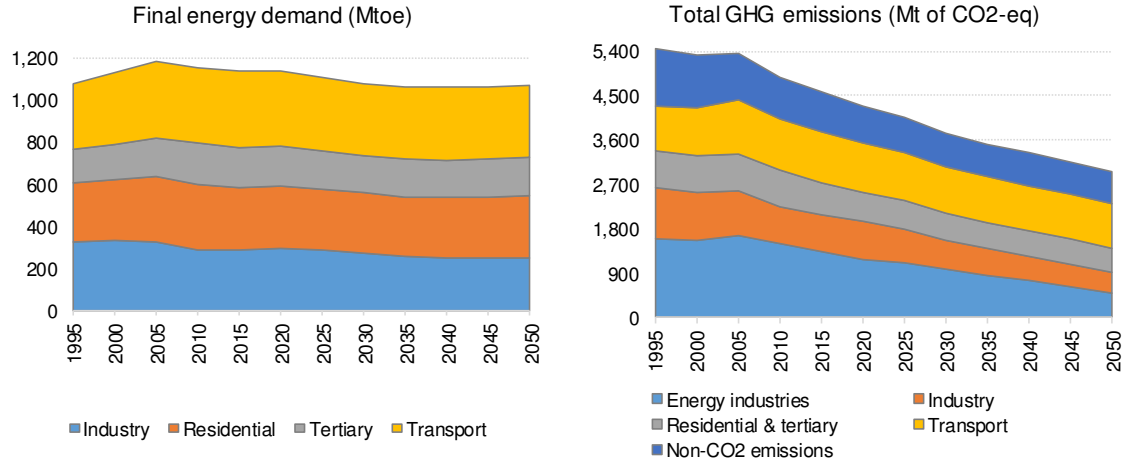
Transport activity of freight inland navigation[44] also benefits from the completion of the TEN-T core and comprehensive network, the promotion of inland waterway transport and the recovery in the economic activity and would grow by 26% by 2030 (1.2% per year) and by 46% during 2010-2050 (0.9% per year).

International maritime transport activity is projected to continue growing strongly with rising demand for oil, coal, steel and other primary resources – which would be more distantly sourced – increasing by 37% by 2030 and by 71% during 2010-2050.

Transport accounts today for about one third of final energy consumption. In the context of growing activity, energy use in transport is projected to decrease by 5% between 2010 and 2030 and to stabilise post-2030 (see Figure 4-3). These developments are mainly driven by the implementation of the Regulations setting emission performance standards for new light duty vehicles. Light duty vehicles are currently responsible for around 60% of total energy demand in transport but this share is projected to significantly decline over time, to 53% by 2030 and 49% by 2050. Energy use in passenger cars and passenger vans is projected to go down by 19% during 2010-2030 (-24% for 2010-2050). Heavy goods vehicles are projected to increase their share in final energy demand from 2010 onwards, continuing the historic trend from 1995. Energy demand by heavy goods vehicles would grow by 14% between 2010 and 2030 (23% for 2010-2050).

Bunker fuels for air and maritime transport are projected to increase significantly: by 17% by 2030 (33% for 2010-2050) and 24% by 2030 (42% for 2010-2050), respectively.

Figure 4-3: Evolution of total final energy consumption and GHG emissions for 1995-2050



Source: Baseline scenario, PRIMES model (ICCS-E3MLab)

Electricity use in transport is expected to increase steadily as a result of further rail electrification and the uptake of alternative powertrains in road transport; its share increases from 1% currently to 3% in 2030 and 4% in 2050. Battery electric and plug-in hybrid electric vehicles are expected to see faster growth beyond 2020, in particular in the segment of light duty vehicles, driven by EU and national policies offering various

[44] Inland navigation covers inland waterways and national maritime.

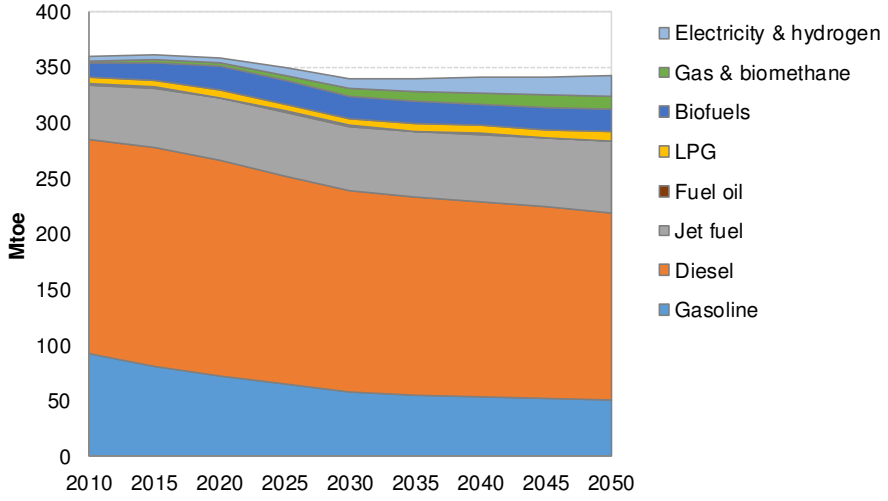
incentives and the decrease in battery costs. The share of battery electric and plug-in hybrid electric vehicles in the total light duty vehicle stock would reach about 6% by 2030 and 15% by 2050 (with the shares of battery electric being 2% in 2030 and 6% in 2050). The uptake of hydrogen would be facilitated by the increased availability of refuelling infrastructure, but its use would remain limited in lack of additional policies beyond those assumed in the Baseline scenario. Fuel cells would represent about 3% of the light duty vehicle stock by 2050.

LNG becomes a candidate energy carrier for road freight and waterborne transport, especially in the medium to long term, driven by the implementation of the Directive on the deployment of alternative fuels infrastructure and the revised TEN-T guidelines which represent important drivers for the higher penetration of alternative fuels in the transport mix. In the Baseline scenario, the share of LNG is projected to go up to 3% by 2030 (8% by 2050) for road freight and 4% by 2030 (7% by 2050) for inland navigation. LNG would provide about 4% of maritime bunker fuels by 2030 and 10% by 2050 – especially in the segment of short sea shipping.

Biofuels uptake is driven by the legally binding target of 10% renewable energy in transport (Renewables Directive), as amended by the ILUC Directive, and by the requirement for fuel suppliers to reduce the GHG intensity of road transport fuel by 6% (Fuel Quality Directive). Beyond 2020, biofuel levels would remain relatively stable at around 6% in the Baseline scenario. The Baseline scenario does not take into account the recent proposal by the Commission for a recast of the Renewables Energy Directive.

In the Baseline scenario, **oil products would still represent about 90% of the EU transport sector needs in 2030** and 85% in 2050, despite the renewables policies and the deployment of alternative fuels infrastructure which support some substitution effects towards biofuels, electricity, hydrogen and natural gas (see Figure 4-4).

Figure 4-4: Evolution of final energy use in transport by type of fuel



Source: Baseline scenario, PRIMES-TREMOVE transport model (ICCS-E3MLab)

The **declining trend in transport emissions is expected to continue**, leading to 13% lower emissions by 2030 compared to 2005, and 15% by 2050.[45] However, relative to 1990 levels, emissions would still be 13% higher by 2030 and 10% by 2050, owing to the fast rise in the transport emissions during the 1990s. The share of transport in total GHG

[45] Including international aviation but excluding international maritime and other transportation.

emissions would continue increasing, going up from 23% currently (excluding international maritime) to 25% in 2030 and 31% in 2050, following a relatively lower decline of emissions from transport compared to power generation and other sectors (see Figure 4-3). Aviation would contribute an increasing share of transport emissions over time, increasing from 14% today to about 18% in 2030 and 21% in 2050. Maritime bunker fuel emissions are also projected to grow strongly, increasing by 22% during 2010-2030 (38% for 2010-2050).

CO_2 emissions from road freight transport (heavy goods and light goods vehicles) are projected to increase by 6% between 2010 and 2030 (11% for 2010-2050) in the Baseline scenario. For heavy goods vehicles, the increase would be somewhat higher (10% for 2010-2030 and 17% for 2010-2050), in lack of specific measures in place. At the same time, emissions from passenger cars and passenger vans are projected to decrease by 22% between 2010 and 2030 (32% for 2010-2050) thanks to the CO_2 standards in place and the uptake of electromobility. CO_2 emissions from buses and coaches are projected to remain relatively unchanged by 2030 compared to their 2010 levels, and to slightly increase post-2030 (3% increase for 2010-2050).

The overall trend in transport emissions is determined by three broad components: transport activity levels (expressed in passenger or tonne-kilometres), the energy intensity of transport (defined as energy consumption per passenger or tonne-kilometre) and the carbon intensity of the energy used (given by the CO_2 emissions divided by energy consumption). Following this approach, it has been evaluated how much the projected transport emissions will increase/decrease (in percentage terms or Mt of CO_2) between 2010 and 2030 due to transport activity growth, improvements in energy intensity and carbon intensity (see Figure 4-5).[46,47]

Overall, CO_2 emissions from passenger transport decrease by 14% (109 Mt of CO_2) between 2010 and 2030 in the Baseline scenario. The 14% decrease in CO_2 emissions from passenger transport is due to transport activity growth (+21%, equivalent to 165 Mt of CO_2), improvements in energy intensity (-31%, equivalent to 246 Mt of CO_2) and in carbon intensity (-4%, equivalent to 28 Mt of CO_2). The trend for the three components and their contribution to emissions is different by transport mode. Efficiency gains play a decisive role in reducing emissions in road transport, while in aviation they would not offset the activity growth leading to higher fuel use and emissions. The use of less CO_2 intensive fuels contributes to a reduction of emissions for road and rail passenger transport with no effect on aviation by 2030.

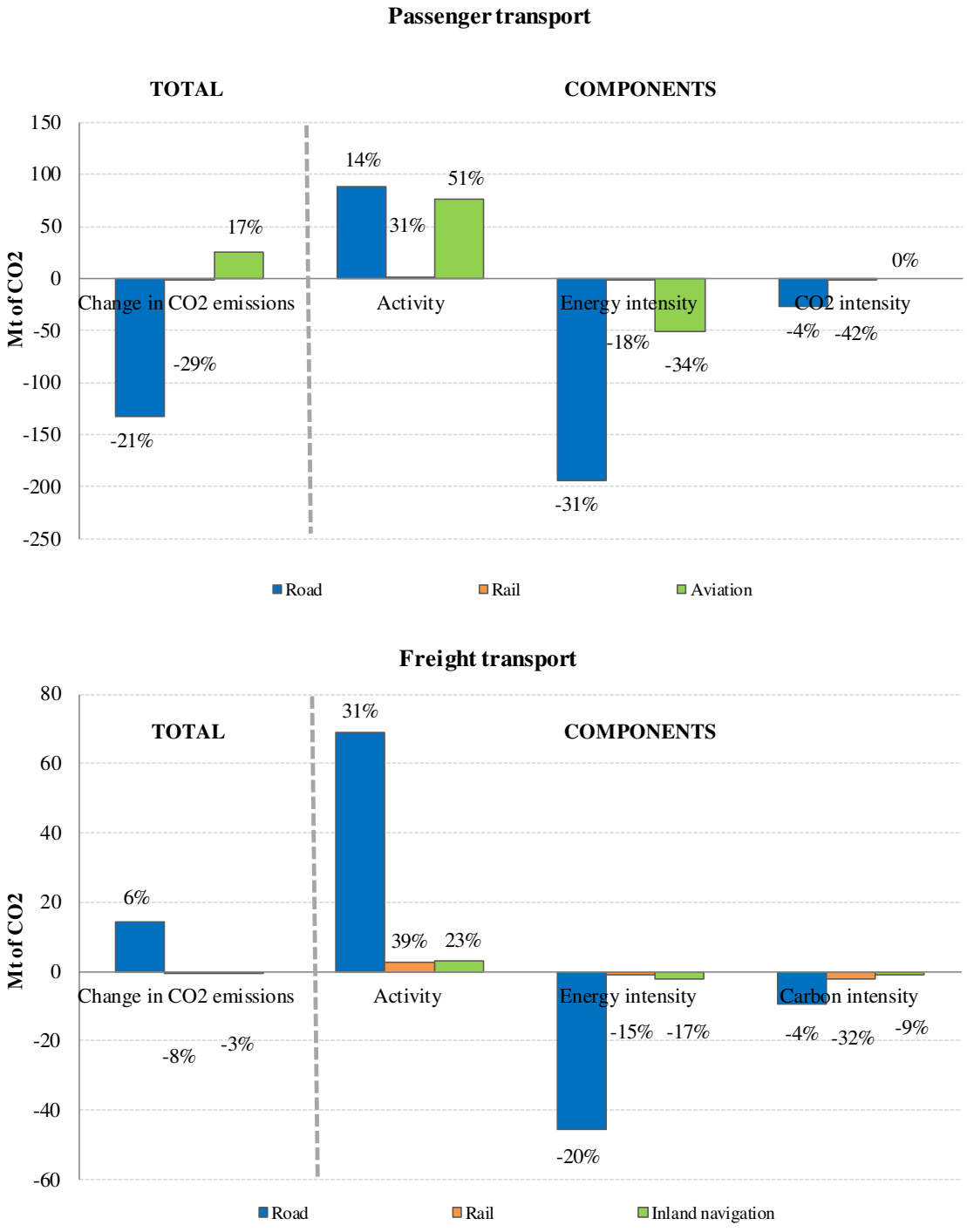
For freight transport, the 5% (13 Mt of CO_2) increase in CO_2 emissions between 2010 and 2030 is the result of transport activity growth (+30%, equivalent to 75 Mt of CO_2), improvements in energy intensity (-20%, equivalent to 49 Mt of CO_2) and in carbon intensity (-5%, equivalent to 13 Mt of CO_2). The efficiency gains and the uptake of alternative fuels for road freight transport are not sufficient to offset the effects of activity growth, and thus CO_2 emissions go up between 2010 and 2030. The electrification in rail has positive effects on emissions, despite the growth in traffic volumes. For inland

[46] The proposed method is the Montgomery decomposition. For a recent application of the method see: De Boer, P.M.C. (2008) Additive Structural Decomposition Analysis and Index Number Theory: An Empirical Application of the Montgomery Decomposition, Economic Systems Research, 20(1), pp. 97-109.

[47] The decomposition analysis only takes into account the tank to wheel emissions, under the assumption that biofuels are carbon neutral.

navigation, efficiency gains and to some lower extent the uptake of LNG has also positive effects on emissions reduction.

Figure 4-5: Decomposition of CO_2 emissions in the Baseline scenario (2010-2030)



Source: EC elaboration based on the Baseline scenario, PRIMES-TREMOVE transport model (ICCS-E3MLab)

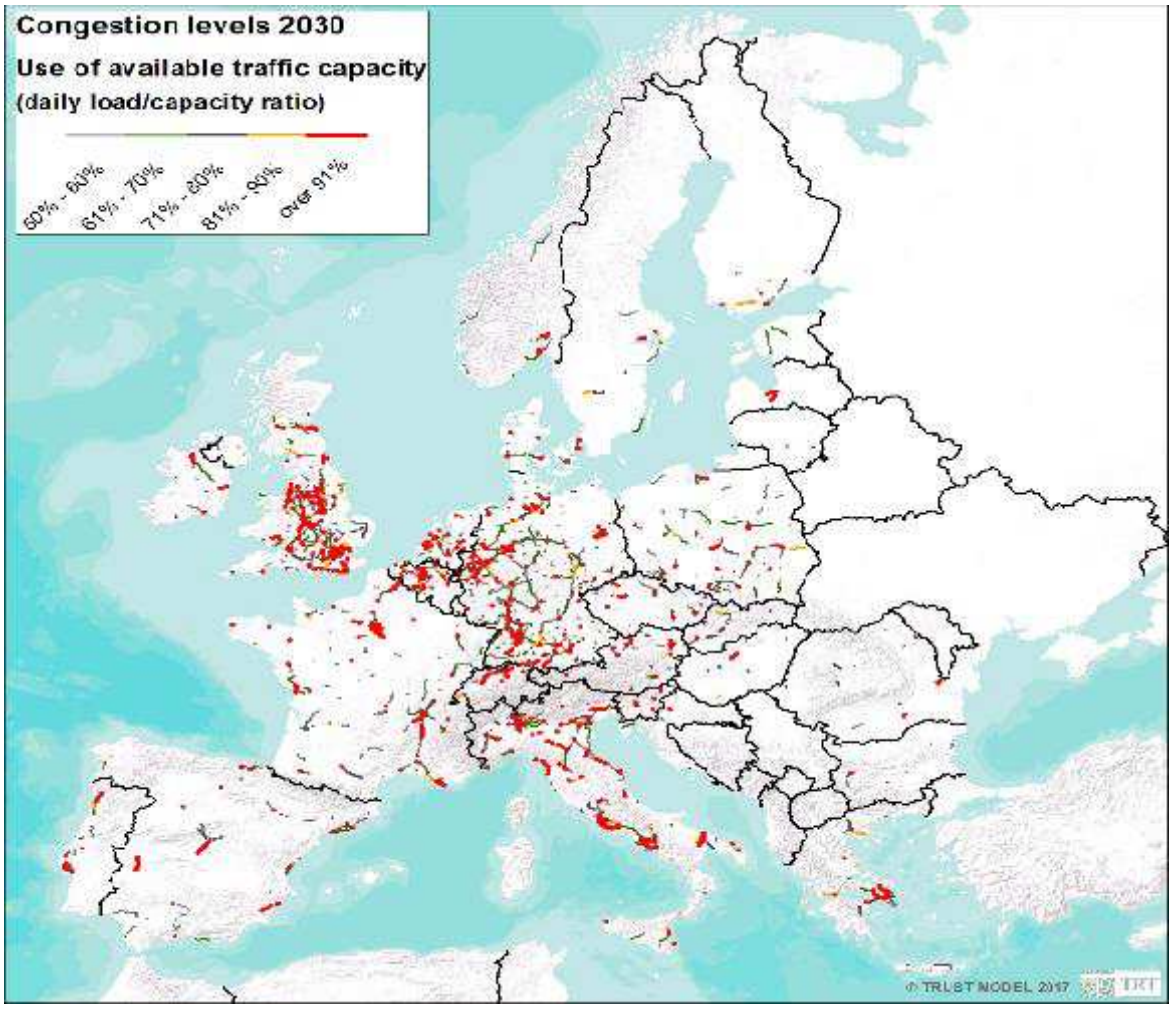
Note: The figures report the changes in CO_2 emissions due to the three broad components (transport activity levels, energy intensity of transport and carbon intensity of the energy used) in two ways: in levels and in relative terms compared to 2010. The size of each column bar, read on the left axis, represents the change in terms of CO_2 emissions compared to 2010, expressed in Mt of CO_2. The percentage changes reported above the column bars represent relative changes in these emissions compared to their respective 2010 levels. Provided that CO_2 levels for 2010 corresponding to each transport mode are not comparable in size, the

percentage changes reported in the figures are not directly comparable. The figures above include only tank to wheel emissions.

NOx emissions would drop by about 56% by 2030 (64% by 2050) with respect to 2010 levels. The decline in **particulate matter** (PM2.5) would be less pronounced by 2030 at 51% (65% by 2050). By 2030, over 75% of heavy goods vehicle stock is projected to be Euro VI in the Baseline scenario and more than 80% of the passenger cars stock is projected to be Euro 6. Overall, external costs related to air pollutants would decrease by about 56% by 2030 (65% by 2050).[48]

High congestion levels are expected to seriously affect road transport in several Member States by 2030 in the absence of effective countervailing measures such as road pricing. While urban congestion will mainly depend on car ownership levels, urban sprawl and the availability of public transport alternatives, congestion on the inter-urban network would be the result of growing freight transport activity along specific corridors, in particular where these corridors cross urban areas with heavy local traffic (see Figure 4-6). The largest part of congestion will be concentrated near densely populated zones with high economic activity such as Belgium and the Netherlands – to a certain extent as a result of port and transhipment operations – and in large parts of Germany, the United Kingdom and northern Italy. Congestion patterns differ significantly among Member States though, since their hourly, daily and seasonal variation depends on local conditions.

Figure 4-6: Congestion levels on the inter-urban network in the Baseline scenario for 2030



Source: TRUST model

[48] External costs are expressed in 2013 prices. They cover NOx, PM2.5 and SOx emissions.

Estimating the costs of congestion is not straightforward, because it occurs mostly during certain times of the day, often caused by specific bottlenecks in the network. In the Baseline scenario, total **congestion costs for urban and inter-urban network are projected to increase** by about 24% by 2030 and 43% by 2050, relative to 2010.

Noise related external costs of transport would continue to increase, by about 17% during 2010-2030 (24% for 2010-2050), driven by the rise in traffic. Thanks to policies in place, external **costs of accidents** are projected to go down by about 46% by 2030 (-42% for 2010-2050) – but still remain high at over €100 billion in 2050. Overall, external costs[49] are projected to decrease by about 10% by 2030 and to increase post-2030; by 2050 they stabilise around levels observed in 2010.

4.3. Detailed description of the policy measures and assumptions used in the Policy Options

4.3.1. Policy Option 1

PO1 builds on the Baseline scenario and additionally includes the following modelling assumptions (see **Figure 4-7** for a summary of measures by Member State):

- **Remove exemptions for HGVs below 12 tonnes:** it is assumed that time-based charges for HGVs below 12 tonnes are introduced in Denmark, Luxembourg, the Netherlands, Sweden and the United Kingdom starting from 2025. The rates for HGVs below 12 tons are set at 65% of those already existing for HGVs above 12 tons. For Germany an extension of the tolling system to HGVs below 7.5 tons is assumed from 2020 onwards.
- **Promote zero-emission vehicles by allowing reduced rates:** starting with 2020 it is assumed that zero-emission HGVs and buses are exempt from charging and zero-emission vans and cars benefit of a 50% reduction.[50]
- **Extension of mark-ups beyond mountain regions:** introduction of mark-ups is assumed on some roads in France and in Slovenia. For modelling purposes plans for mark-ups are mainly assumed in mountain regions; this is because they are the only real examples available to test the introduction of possible future schemes. These examples can also show the possible differences in effect on larger and smaller Member States.
- **Reviewing of maximum values for external cost charging** to better reflect external costs of air pollution and noise. The maximum permissible external cost charge limits and the external cost charges currently applied in Germany and Austria[51] are provided in Annex 5. For modelling purposes, in PO1 it is assumed that external costs are increased from 2020 onwards in Germany for HGVs and in Austria for HGVs and buses according to the values of the 2014 Handbook on external costs of transport[52]. The review implies using more proportionate values for external cost charges, i.e. differentiated according to vehicle weight (heavier trucks pollute more than lighter ones). The values do not change between policy options and are set in line with the 2014 Handbook on external costs of transport.

[49] External costs cover here air pollution, congestion, noise and accidents.
[50] Reduced rates are implemented only in Member States where road charging systems are in place.
[51] Currently these are the only Member States making use of this possibility offered by Directive 1999/62/EC
[52] Ricardo-AEA et al (2014), Update of the Handbook on External Costs of Transport: http://ec.europa.eu/transport/themes/sustainable/studies/sustainable_en

Figure 4-7: Summary of policy measures introduced in PO1 relative to the Baseline

			AT	BE	BG	CY	CZ	DE[53]	DK	EE	EL	ES	FI	FR	HR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Road infrastructure charge variations	**Vignette**	HGV <12t																												
		HGV >12 t																												
		Buses																												
		Vans																												
		Cars																												
	Toll	HGV <12t																												
		HGV >12 t																												
		Buses																												
		Vans																												
		Cars																												
Phasing out vignette		HGV																												
		Buses																												
		Vans																												
		Cars																												
Phasing out EURO Class modulation		HGV																												
		Buses																												
Phasing in CO2/pollutant modulation		HGV																												
		Buses																												
		Vans																												
		Cars																												
Rebates for zero emission vehicles		HGV																												
		Buses																												
		Vans																												
		Cars																												
External costs[54]		HGV																												
		Buses																												
Congestion charging		All																												
Mark-ups		HGV																												
		Buses																												
Reduced circulation taxes		HGV																												

Note: measures included in PO1 relative to the Baseline are reported in green.

[53] In PO1 tolls for HGVs also apply below 7.5 t.

[54] In the context of reviewing the maximum values for external cost charging to better reflect external costs for air pollution and noise, the charges for HGVs and buses for Austria and for HGVs for Germany are increased in line with the values of the 2014 Handbook on external costs of transport.

4.3.2. Policy option 2

PO2 builds on PO1 and additionally includes the following modelling assumptions:

- **Phase out vignettes for HGVs above 3.5 tonnes and buses** starting in 2025[55] with the introduction of new distance based charging systems in Denmark, Lithuania, Luxembourg, Latvia, the Netherlands, Romania, Sweden and the United Kingdom and the extension of the existing ones to cover also buses in Belgium, Germany and Hungary. Additionally, for Bulgaria the phasing out of vignette for HGV is assumed starting with 2020[56]. The average charges assumed for modelling purposes are summarised in Figure 4-8.

Figure 4-8: Assumed average distance-base charges replacing existing vignettes (€cent/km)

Country	HGV 3.5t - 12t	HGV> 12 t	Buses
BE	Unchanged	Unchanged	13,5
BG	8,18	14,49	8,18
DE	13,5	Unchanged	13,5
DK	13,5	16,3	13,5
HU	Unchanged	Unchanged	11,7
LT	8,18	14,49	8,18
LU	13,5	16,3	13,5
LV	8,18	14,49	8,18
NL	13,5	16,3	13,5
RO	8,18	14,49	8,18
SE	13,5	16,3	13,5
UK	13,5	16,3	13,5

- **Phase out Euro class-differentiation and more extensive use of external cost charging** starting in 2025. The measure is simulated through the elimination of modulation of infrastructure charges by Euro class in all Member States where it is applied and the assumed introduction of external cost charging for air and noise pollution in those Member States, based on 2014 Handbook on external costs of transport[57]. More specifically, external cost charging for HGVs would be additionally applied in PO2 in Belgium, Bulgaria, Czech Republic, Denmark, Hungary, Lithuania, Latvia, Luxembourg, the Netherlands, Poland, Sweden, Slovenia and Slovakia and for buses in Bulgaria, Czech Republic, Lithuania, Latvia, Poland, Slovenia and Slovakia.

- **Phasing in of revenue-neutral modulation of infrastructure charges according to CO_2 emissions for HGVs above 3.5 tonnes and buses** starting in 2025. The measure is assumed to apply in all Member States except Cyprus, Estonia, Finland and Malta (where no charging system is applied). The revised charges are based on the results of the PRIMES-TREMOVE model (ICCS-E3MLab)[58]. The assumptions used for the modulation of infrastructure charges according to CO_2 emissions are provided in **Figure 4-9**.

[55] Assumptions about changes in the charging systems were made in 5-year steps. The assumptions regarding the timing of the introduction of the measures are conservative, considering the uncertainty.

[56] The time of the introduction of the measure has been assumed in line with the Government plans. These plans have not yet been adopted in law and thus they are not considered in the Baseline.

[57] http://ec.europa.eu/transport/themes/sustainable/internalisation_en

[58] This measure has been modelled in two steps. In the first step, the PRIMES-TREMOVE model has been run. In the second step, PRIMES-TREMOVE results (i.e. the structure of the vehicle fleet by type of powertrain, age and its evolution; the increase in road charges for vehicles with CO_2 emissions above the average) have been used in defining the integrated policy package in ASTRA model.

Figure 4-9: Assumptions used for the modulation of infrastructure charges according to CO_2 emissions for HGVs and buses/coaches

Environmental performance	Euro 0-VI	New low CO_2-emission vehicles[59]
Heavy goods vehicles between 3.5 tonnes and 7.5 tonnes plus buses/coaches	Charge above average rate	Assume 25% reduction in charges versus Euro 0-VI
Heavy goods vehicles above 7.5 tonnes	Charge above average rate	Assume 25% reduction in charges versus Euro 0-VI

- **Rebates for all zero emission vehicles** are assumed starting with 2020 in almost all MSs (except Cyprus, Estonia, Finland and Malta where no charging system is applied). Rebates imply the full exemption from tolls for zero emission HGV and buses and 50% reduction for zero emission vans and passenger cars. Exemptions for HGV below 12 tonnes are phased in from 2025 onwards in Denmark, Lithuania, Luxembourg, Latvia, the Netherlands, Romania, Sweden and the United Kingdom, and from 2020 onwards for BG[60].
- **Reduction of circulation taxes for HGV above 12 tonnes and below 12 tonnes**, according to **Figure 4-10**, where a 50% reduction is assumed for distance-based systems already in place and exemptions for new distance-based systems.

Figure 4-10: Implementation of reduced circulation taxes

Country	HGVs > 12 tonnes and HGVs < 12 tonnes
AT	2020 (50% reduction)
BE	2020 (50% reduction)
BG	2020 (Exemption)
CY	-
CZ	2020 (50% reduction)
DE	2020 (50% reduction)
DK	2025 (Exemption)
EL	2020 (50% reduction)
ES	2020 (50% reduction)
FR	2020 (50% reduction)
HR	2020 (50% reduction)
HU	2020 (50% reduction)
IE	2020 (50% reduction)
IT	2020 (50% reduction)
LT	2025 (Exemption)
LU	2025 (Exemption)
LV	2025 (Exemption)
MT	-
NL	2025 (Exemption)
PL	2020 (50% reduction)
PT	2020 (50% reduction)
RO	2025 (Exemption)
SE	2025 (Exemption)
SI	2020 (50% reduction)
SK	2020 (50% reduction)
UK	2025 (Exemption)

Figure 4-11 below provides a summary of the measures included in PO2, by Member State.

[59] 'Low emission' vehicles are defined as below the average (VECTO baseline).

[60] Differences in the timing of introduction are linked to the introduction of distance-based systems in these Member States.

Figure 4-11: Summary of policy measures introduced in PO2 relative to the Baseline

			AT	BE	BG	CY	CZ	DE	DK	EE	EL	ES	FI	FR	HR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Road infrastructure charge variations	Vignette	HGV <12t																												
		HGV >12t																												
		Buses																												
		Vans																												
		Cars																												
	Toll	HGV <12t																												
		HGV >12t																												
		Buses																												
		Vans																												
		Cars																												
Phasing out vignette		HGV																												
		Buses																												
		Vans																												
		Cars																												
Phasing out EURO Class modulation		HGV																												
		Buses																												
Phasing in CO2/pollutant modulation		HGV																												
		Buses																												
		Vans																												
		Cars																												
Rebates for zero emission vehicles		HGV																												
		Buses																												
		Vans																												
		Cars																												
External costs		HGV																												
		Buses																												
Congestion charging		All																												
Mark-ups		HGV																												
		Buses																												
Reduced circulation taxes		HGV																												

Note: measures included in PO1 and PO2 are reported in green; additional measures included in PO2 are reported in blue.

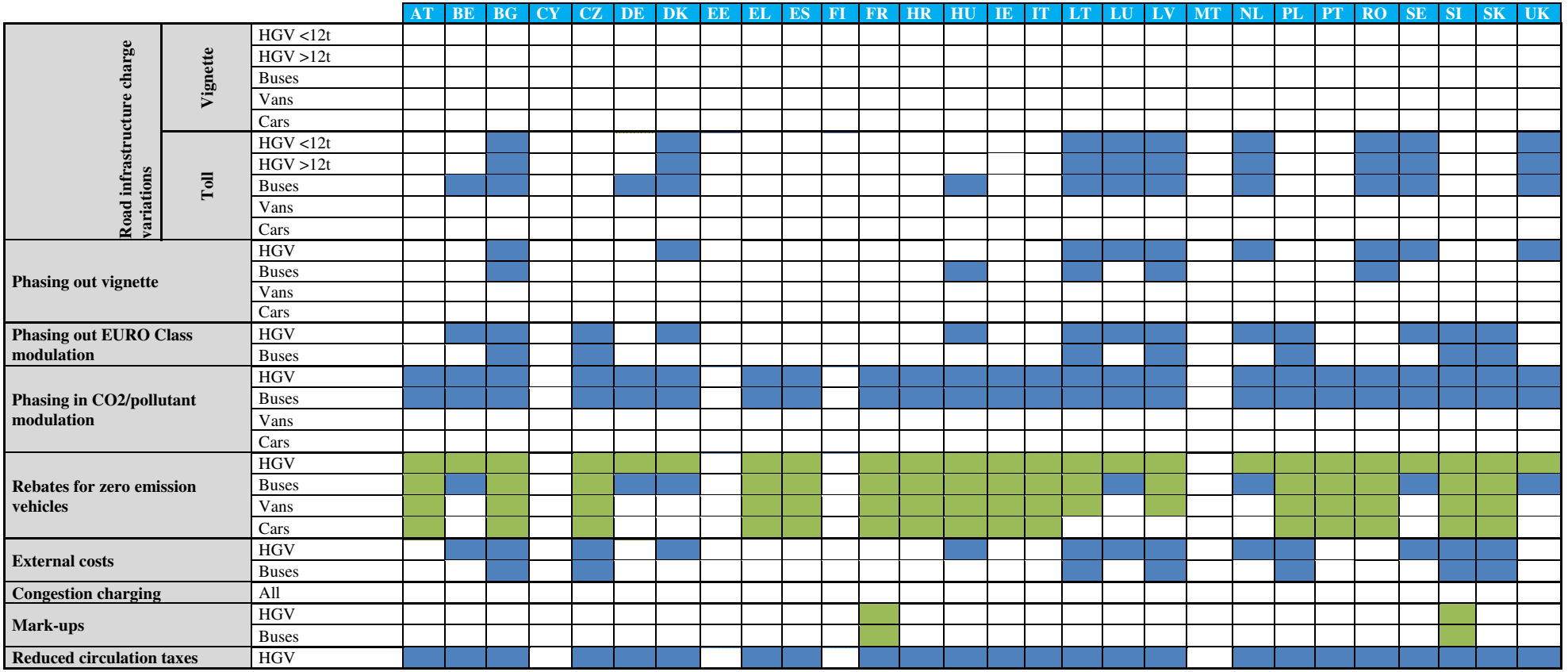
4.3.3. Policy option 2 – sensitivity case (PO2s)

PO2s (sensitivity case) builds on PO2 but additionally includes the following modelling assumptions:

- Phase-in of distance-based charges for all HGVs and buses in Estonia and Finland starting with 2025.
- Phase-in of revenue-neutral modulation of infrastructure charges according to CO_2 emissions for HGVs above 3.5 tonnes and buses starting with 2025 for Estonia and Finland. Similarly to PO2, the revised charges are based on the results of the PRIMES-TREMOVE model (ICCS-E3MLab).
- Rebates for all zero emission vehicles starting with 2025 in Estonia and Finland.
- Exemption of circulation taxes for HGVs from 2025 onwards in Estonia and Finland.

Figure 4-12 below provides a summary of the measures included in PO2s, by Member State.

Figure 4-12: Summary of policy measures introduced in PO2s (sensitivity case) relative to the Baseline



Note: measures included in PO1 and PO2 are reported in green; measures included in PO2 and PO2s are reported in blue; additional measures included in PO2s are reported in light blue.

4.3.4. Policy option 3a

PO3a builds on PO2 and additionally includes the following modelling assumptions:

- **Phase in genuine congestion charging in distance-based environment for all vehicles,** i.e. in Greece, Spain, France, Croatia, Ireland, Italy, Poland and Portugal[61] from 2025.

The modelling of congestion charging required the identification of potential congested links where charges should be phased in. The identification of the most congested links is made on the basis of the TRUST model's output of road traffic assignment in 2030, assuming a load/capacity ratio of 0.5 computed on daily traffic as representative of congestion during peak time (Figure 4-13).

Figure 4-13: Congested links in TRUST 2030 network (Daily load/capacity ratio >= 0.5)

[61] These are the Member States currently applying distance-based charging for all vehicle categories, therefore the only ones that can make use of the instrument.

Source: TRUST model

The level of additional charges is based on the specific country values for traffic conditions close to road capacity available from the 2014 Handbook on external costs of transport[62], detailed by road type (motorways and main roads) and vehicle type.

The daily average charges are expressed in 2015 prices. To translate peak charges into average daily charges the share of cars and HDV traffic in the peak periods (from 7:00 to 11:00 and from 16:00 to 20:00) has been used, considering the available set of real traffic data for motorways and main roads in EU countries.

The average daily congestion charges modelled in PO3a are summarised in Figure 4-14.

Figure 4-14: Average daily efficient marginal congestion costs, € per vkm

	Car		Rigid truck		Articulated truck		Bus	
Country	Motorway	Main Roads	Motorway	Main Roads	Motorway	Main Roads	Motorway	Main Roads
EL	0,074	0,093	0,108	0,163	0,165	0,249	0,142	0,215
ES	0,082	0,104	0,121	0,182	0,184	0,278	0,159	0,24
FR	0,089	0,112	0,13	0,196	0,198	0,3	0,171	0,258
HR	0,049	0,062	0,072	0,108	0,109	0,165	0,094	0,142
IE	0,105	0,132	0,154	0,232	0,235	0,354	0,202	0,305
IT	0,083	0,105	0,122	0,184	0,186	0,28	0,16	0,242
PL	0,052	0,065	0,076	0,114	0,115	0,174	0,099	0,15
PT	0,066	0,083	0,096	0,146	0,147	0,222	0,127	0,191

Additional assumptions on maximum congestion charges are made considering the specific length of the congested links in the TRUST model network. Given the strategic level of the network implemented in European models such as TRUST, links are generally characterized by a certain length (e.g. 20–30 km) and the increase of charges due to congestion should consider only a portion of the link to reflect the real situation where, if congestion occurs, it is generally localised a on shorter portion of the links. In this respect, a threshold of 10 kilometres is imposed.

A feedback of the results obtained from TRUST into the ASTRA model (as an exogenous input) allowed for ASTRA indicators to include the impact of congestion charging. Specifically, TRUST provided the share of traffic (by vehicle type) travelling on links subject to congestion charging with respect to the total traffic on tolled road network in each NUTS I zone of a country. These shares were used to calculate the average value of congestion charge (applied on top of the infrastructure charge) at the NUTS I level, which was introduced in ASTRA as an input to calculate travel costs, affecting modal split and revenues from road charging.

Figure 4-15 below provides a summary of the measures assessed in in PO3a, by Member State.

[62] http://ec.europa.eu/transport/themes/sustainable/internalisation_en

Figure 4-15: Summary of policy measures introduced in PO3a relative to the Baseline

			AT	BE	BG	CY	CZ	DE	DK	EE	EL	ES	FI	FR	HR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Road infrastructure charge variations	Vignette	HGV <12t																												
		HGV >12t																												
		Buses																												
		Vans																												
		Cars																												
	Toll	HGV <12t																												
		HGV >12t																												
		Buses																												
		Vans																												
		Cars																												
Phasing out vignette		HGV																												
		Buses																												
		Vans																												
		Cars																												
Phasing out EURO Class modulation		HGV																												
		Buses																												
Phasing in CO2/pollutant modulation		HGV																												
		Buses																												
		Vans																												
		Cars																												
Rebates for zero emission vehicles		HGV																												
		Buses																												
		Vans																												
		Cars																												
External costs		HGV																												
		Buses																												
Congestion charging		All																												
Mark-ups		HGV																												
		Buses																												
Reduced circulation taxes		HGV																												

Note: measures included in PO1, PO2 and PO3a are reported in green; measures included in PO2 and PO3a are reported in blue; measures additionally included in PO3a are provided in purple.

4.3.5. Policy option 3b

PO3b also builds on PO2 and additionally includes the following modelling assumptions:

- **Genuine congestion charging in distance-based environment for all vehicles**, i.e. in Greece, Spain, France, Croatia, Ireland, Italy, Poland and Portugal from 2025. Assumptions concerning congestion charges are the same as in PO3a (see section 4.3.4).
- **Phasing in the modulation of infrastructure charges according to CO_2/pollutant emission for vans and passenger cars** by 2025 as shown in Figure 4-16. The revised charges are based on the results of the PRIMES-TREMOVE model (ICCS-E3MLab)[63].

Figure 4-16: Assumptions used for the modulation of infrastructure charges according to CO_2/pollutant emissions for vans and passenger cars

Environmental performance	Conformity factor above 2.1	Maximum 168 mg NOx and maximum 95 gCO2/km for passenger cars (147 gCO2/km for vans) in 2020	Maximum 80 mg NOx and maximum 95 gCO2/km for passenger cars (147 gCO2/km for vans) from 2021
Charge per km	Above average rate	-15% versus highest rate	-30% versus highest rate

Figure 4-17 below provides a summary of the measures implemented in PO3b by Member State.

[63] This measure has been modelled in two steps. In the first step, the PRIMES-TREMOVE model has been run. In the second step, PRIMES-TREMOVE results (i.e. the structure of the vehicle fleet by type of powertrain, age and its evolution; the increase in road charges for vehicles with CO_2 emissions above the average) have been used in defining the integrated policy package in ASTRA model.

Figure 4-17: Summary of policy measures introduced in PO3b relative to the Baseline

			AT	BE	BG	CY	CZ	DE	DK	EE	EL	ES	FI	FR	HR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Road infrastructure charge variations	Vignette	HGV <12t																												
		HGV >12t																												
		Buses																												
		Vans																												
		Cars																												
	Toll	HGV <12t																												
		HGV >12t																												
		Buses																												
		Vans																												
		Cars																												
Phasing out vignette		HGV																												
		Buses																												
		Vans																												
		Cars																												
Phasing out EURO Class modulation		HGV																												
		Buses																												
Phasing in CO2/pollutant modulation		HGV																												
		Buses																												
		Vans																												
		Cars																												
Rebates for zero emission vehicles		HGV																												
		Buses																												
		Vans																												
		Cars																												
External costs		HGV																												
		Buses																												
Congestion charging		All																												
Mark-ups		HGV																												
		Buses																												
Reduced circulation taxes		HGV																												

Note: measures included in PO1, PO2, PO3a and PO3b are reported in green; measures included in PO2, PO3a and PO3b are reported in blue; measures included in PO3a and PO3b are provided in purple; measures additionally included in PO3b are reported in orange.

4.3.6. Policy option 4

PO4 builds on PO3b and additionally includes the following modelling assumptions:

- **Mandatory external cost charging** for air pollution and noise for HGVs and buses on the TEN-T network in all countries where road charging is applied.
- **Phase out vignettes for vans** by 2025 and phase-in of distance-based charging for these vehicles in Austria, Bulgaria, Czech Republic, Hungary, Lithuania, Latvia, Romania, Slovenia and Slovakia.
- **Phasing out of vignettes for passenger cars and phase-in of distance based charges for passenger cars** in Austria, Bulgaria, Czech Republic, Hungary, Romania, Slovenia and Slovakia.
- **Extension of genuine congestion charging** also to Austria, Bulgaria, Czech Republic, Hungary, Romania, Slovenia and Slovakia. The assumptions used for the average daily congestion charges in PO4, based on the 2014 Handbook on external costs of transport values, are summarised in Figure 4-18.
- **Exemption from circulation taxes** for vans in Austria, Bulgaria, Czech Republic, Hungary, Latvia, Lithuania, Romania, Slovenia and Slovakia from 2025 onwards. Assume a 50% reduction for vans for the distance-based systems already in place in Greece, Spain, France, Croatia, Ireland, Italy, Poland and Portugal from 2020 onwards.

Figure 4-18: Average daily efficient marginal congestion costs, € per vkm

	Car		Rigid truck		Articulated truck		Bus	
Country	Motorway	Main Roads	Motorway	Main Roads	Motorway	Main Roads	Motorway	Main Roads
AT	0,104	0,131	0,152	0,23	0,232	0,351	0,2	0,302
BG	0,036	0,046	0,053	0,080	0,081	0,122	0,070	0,105
CZ	0,066	0,083	0,096	0,145	0,146	0,221	0,126	0,19
EL	0,074	0,093	0,108	0,163	0,165	0,249	0,142	0,215
ES	0,082	0,104	0,121	0,182	0,184	0,278	0,159	0,24
FR	0,089	0,112	0,13	0,196	0,198	0,3	0,171	0,258
HR	0,049	0,062	0,072	0,108	0,109	0,165	0,094	0,142
HU	0,053	0,067	0,078	0,118	0,119	0,18	0,103	0,155
IE	0,105	0,132	0,154	0,232	0,235	0,354	0,202	0,305
IT	0,083	0,105	0,122	0,184	0,186	0,28	0,16	0,242
PL	0,052	0,065	0,076	0,114	0,115	0,174	0,099	0,15
PT	0,066	0,083	0,096	0,146	0,147	0,222	0,127	0,191
RO	0,039	0,049	0,056	0,085	0,086	0,130	0,074	0,112
SI	0,07	0,088	0,102	0,154	0,156	0,236	0,135	0,203
SK	0,06	0,076	0,088	0,134	0,135	0,204	0,116	0,176

Source: TRT elaborations based on 2014 Handbook on external costs of transport

Figure 4-19 below provides a summary of the measures included in PO4, by Member State.

Figure 4-19: Summary of policy measures introduced in PO4 relative to the Baseline

			AT	BE	BG	CY	CZ	DE	DK	EE	EL	ES	FI	FR	HR	HU	IE	IT	LT	LU	LV	MT	NL	PL	PT	RO	SE	SI	SK	UK
Road infrastructure charge variations	Vignette	HGV <12t																												
		HGV >12t																												
		Buses																												
		Vans																												
		Cars																												
	Toll	HGV <12t																												
		HGV >12t																												
		Buses																												
		Vans																												
		Cars																												
Phasing out vignette		HGV																												
		Buses																												
		Vans																												
		Cars																												
Phasing out EURO Class modulation		HGV																												
		Buses																												
Phasing in CO2/pollutant modulation		HGV																												
		Buses																												
		Vans																												
		Cars																												
Rebates for zero emission vehicles		HGV																												
		Buses																												
		Vans																												
		Cars																												
External costs		HGV																												
		Buses																												
Congestion charging		All																												
Mark-ups		HGV																												
		Buses																												
Reduced circulation taxes		HGV																												
		Vans																												

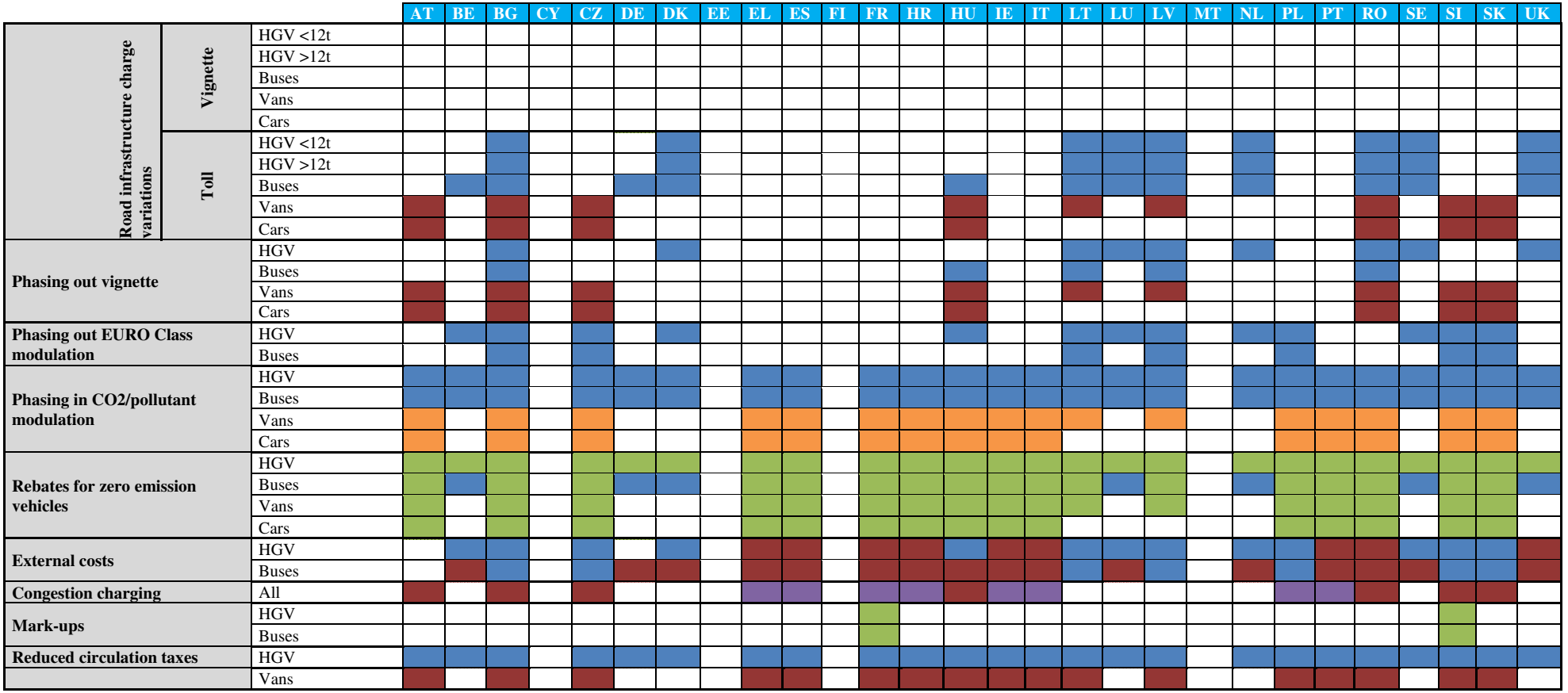
Note: measures included in PO1, PO2, PO3a, PO3b and PO4 are reported in green; measures included in PO2, PO3a, PO3b and PO4 are reported in blue; measures included in PO3a, PO3b and PO4 are provided in purple; measures included in PO3b and PO4 are reported in orange; measures additionally included in PO4 are reported in red.

4.3.7. Policy option 4 – sensitivity case (PO4s)

PO4s builds on PO4 but additionally includes the following modelling assumptions:

- Phase-in of distance-based charges for vans and passenger cars in Belgium, Germany, Luxembourg and Netherlands from 2025 onwards.
- Phase-in of modulation of infrastructure charges according to CO_2/air pollutant emissions for vans and passenger cars starting with 2025 in Belgium, Germany, Luxembourg and Netherlands.
- Rebates for all zero emission vans and passenger cars starting with 2025 in Belgium, Germany, Luxembourg and Netherlands.
- Extension of genuine congestion charging also to Belgium, Germany, Luxembourg and Netherlands.
- Exemption from circulation taxes for vans in Belgium, Germany, Luxembourg and Netherlands from 2025 onwards.

Figure 4-20: Summary of policy measures introduced in PO4s (sensitivity case) relative to the Baseline



Note: measures included in PO1, PO2, PO3a, PO3b, PO4 and PO4s are reported in green; measures included in PO2, PO3a, PO3b, PO4 and PO4s are reported in blue; measures included in PO3a, PO3b, PO4 and PO4s are provided in purple; measures included in PO3b, PO4 and PO4s are reported in orange; measures included in PO4 and PO4s are reported in red; measures additionally included in PO4s are reported in light red.

5. ANNEX 5: ROAD CHARGING SYSTEMS IN THE EU

Figure 5-1: Heavy goods vehicles

Figure 5-2: Light goods vehicles

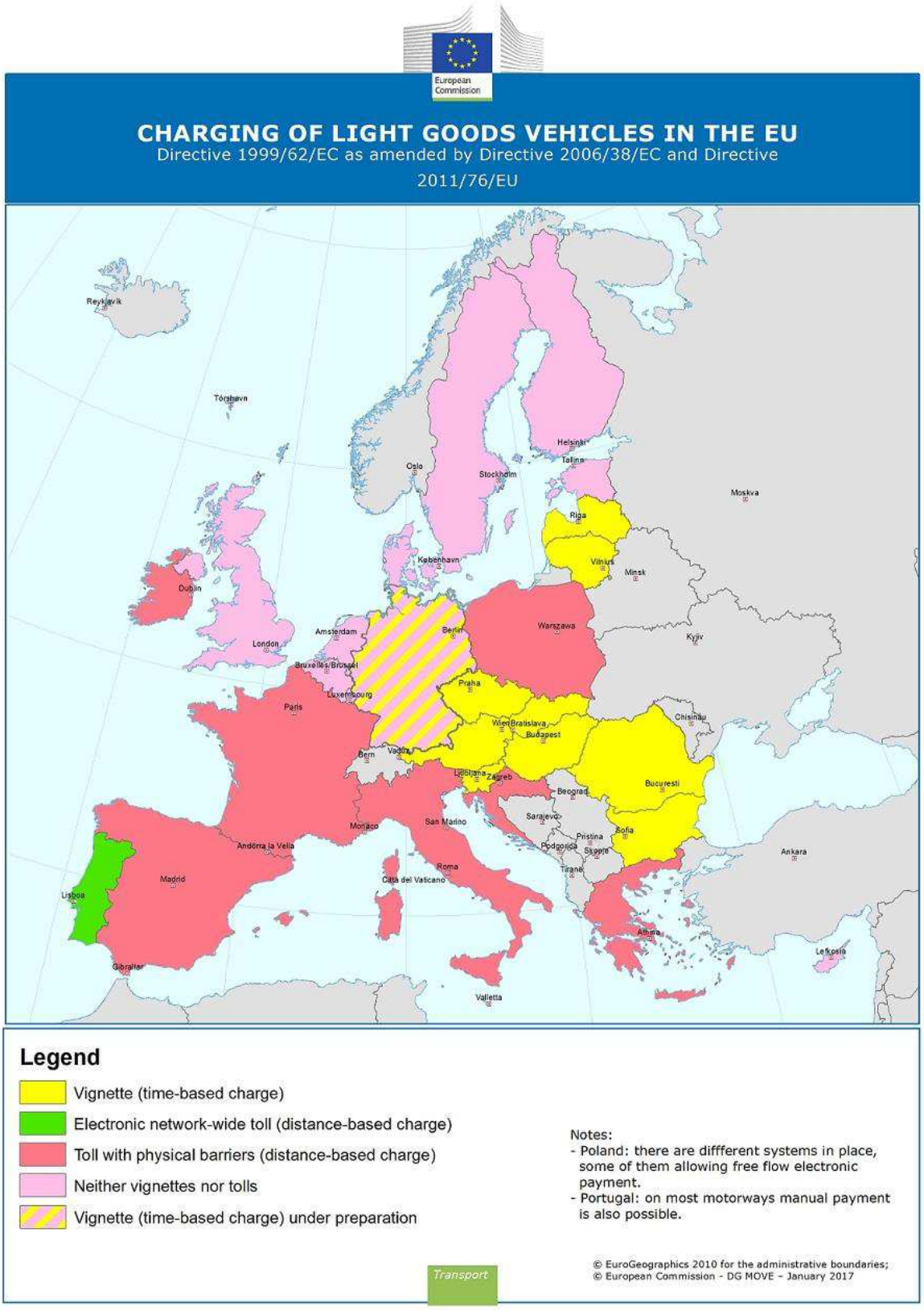


Figure 5-3: Buses and coaches

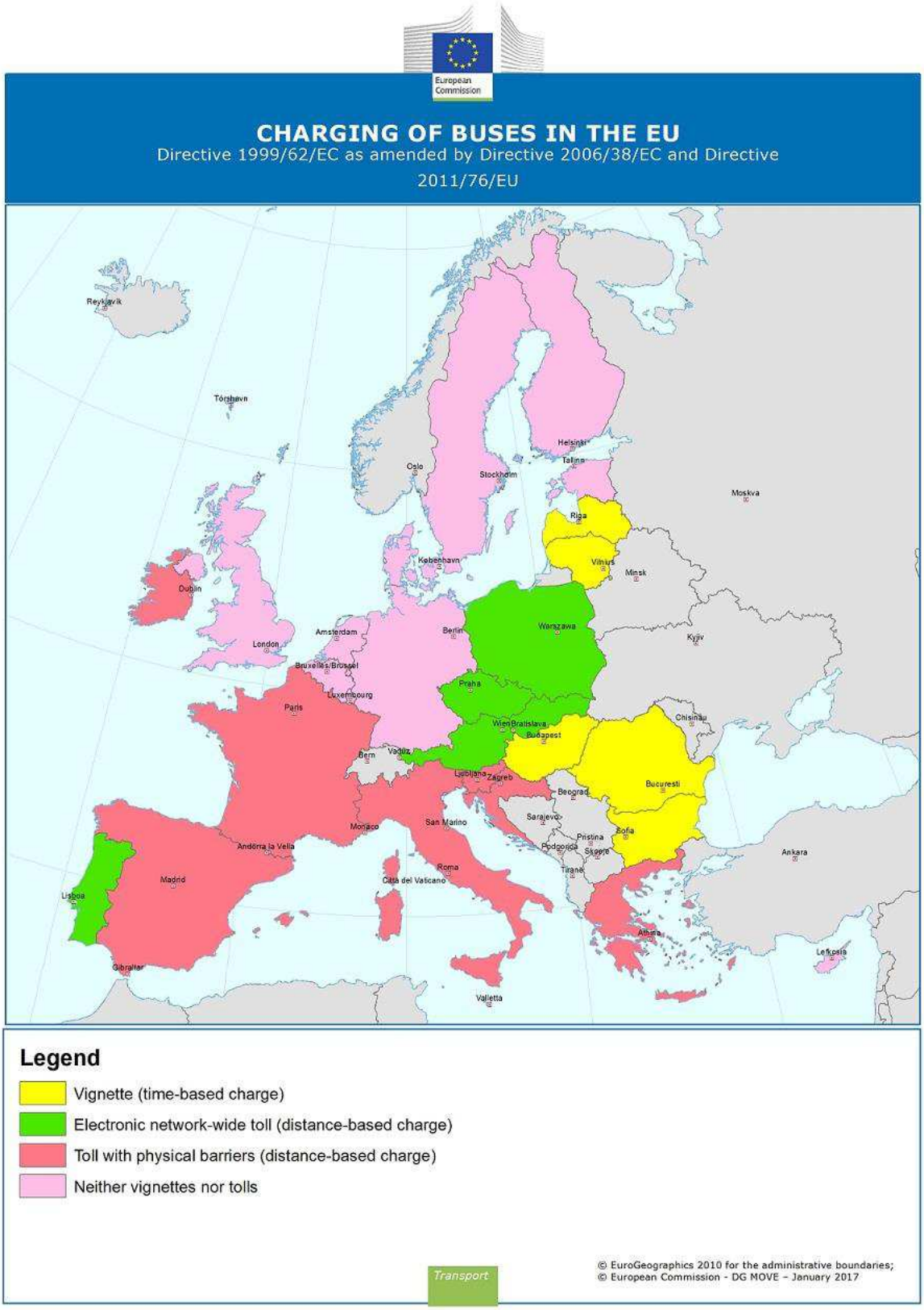


Figure 5-4: Passenger cars

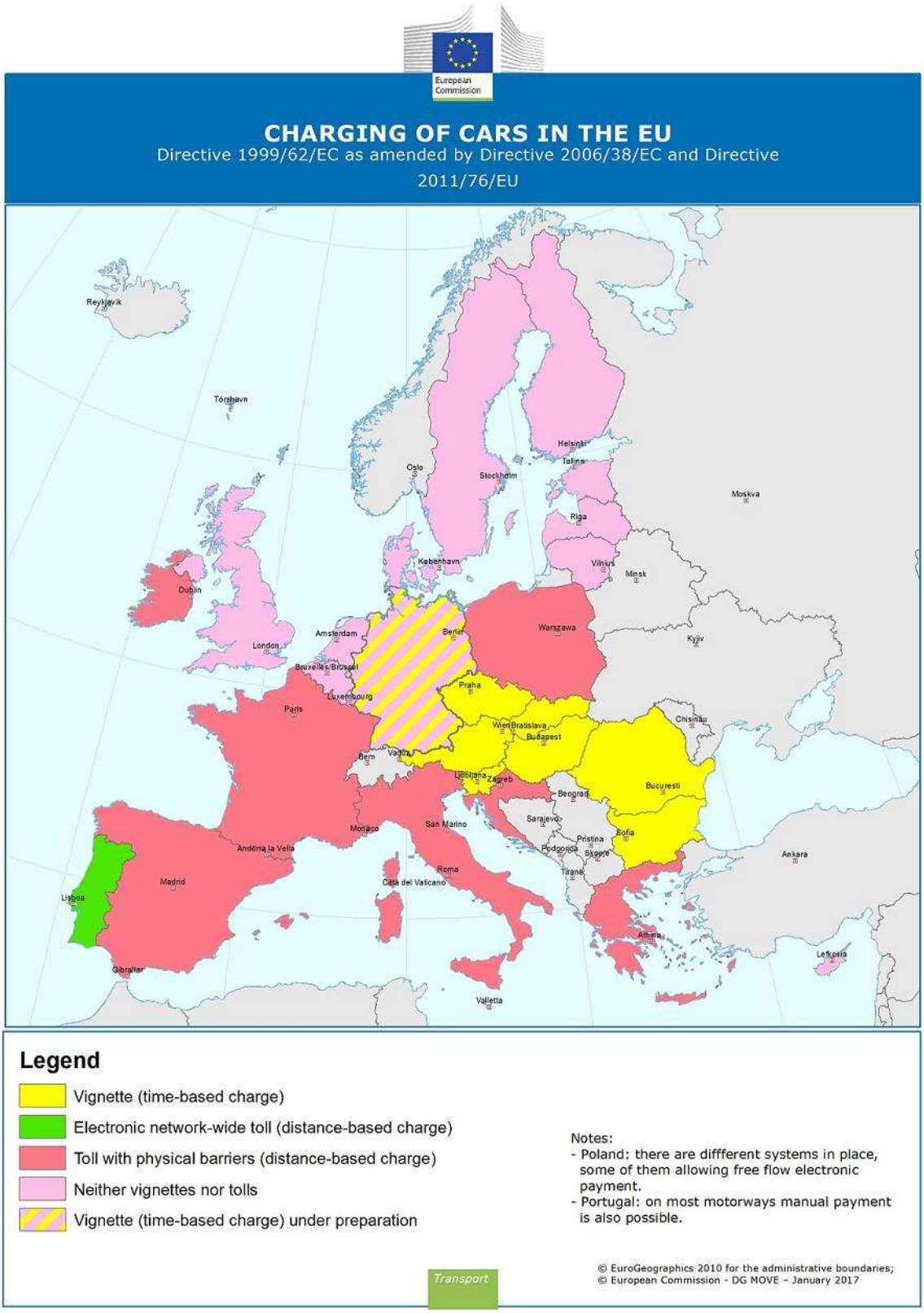


Figure 5-5: HGV external cost charges, covering air pollution costs per kilometre from 1st October 2015, Germany

Emission category	Toll rate [cents], Costs for air pollution
Euro VI	0
EEV 1, Euro V	2.1
Euro IV, Euro III + with particulate reduction class 2	3.2
Euro III, Euro II + with particulate reduction class 1	6.3
Euro II	7.3
Euro I, Euro 0	8.3

Source: (Toll Collect, 2016). These charges are independent of the number of axles of the vehicle and the type of road (BMJV, 2015).

Figure 5-6: HGV external cost charges, covering air pollution costs per kilometre from 1st January 2017, Austria

Emission category	Toll rate [cents], Costs for air pollution 2 axles	Toll rate [cents], Costs for air pollution 3 axles	Toll rate [cents], Costs for air pollution 4+ axles
Euro VI	---	---	---
EEV, Euro V	1.37	1.92	2.19
Euro IV	2.00	2.80	3.20
Euro 0 - III	4.00	5.60	6.40

Source: (BMVIT, 2016b), Interview input from BMVIT

Figure 5-7: HGV external cost charges, covering noise costs per kilometre from 1st January 2017, Austria

Time	Toll rate [cents], Costs for noise 2 axles	Toll rate [cents], Costs for noise 3 axles	Toll rate [cents], Costs for noise 4+ axles
Day	0.07	0.16	0.20
Night	0.11	0.25	0.32

Source: (BMVIT, 2016b), Interview input from BMVIT

Figure 5-8: Maximum chargeable air pollution cost according to Directive 1999/62/EC

cent/vehicle.kilometre	Suburban roads (including motorways)	Interurban roads (including motorways)
EURO 0	16,9	12,7
EURO I	11,7	8,5
EURO II	9,6	7,4
EURO III	7,4	6,4
EURO IV	4,3	3,2
EURO V	0	0
after 31 December 2013	3,2	2,2
EURO VI	0	0
after 31 December 2017	2,2	1,1
Less polluting than EURO VI	0	0

Updated on 1.06.2016

Figure 5-9: Maximum chargeable noise cost according to Directive 1999/62/EC

cent/vehicle.kilometre	Day	Night
Suburban roads (including motorways)	1,17	2,12
Interurban roads (including motorways)	0,22	0,32

Updated on 1.06.2016

6. ANNEX 6: IMPORTANCE OF ROAD CHARGES IN HGV OPERATING COSTS IN THE EU

A wide variety of different road charging systems exist in the EU and **only a share of vehicles are charged** (section 2.2.3). **Charging schemes differ** not only in the technology they use[64] but also in terms of pricing (section 2.2.5), which provide contradictory incentives to the user. While differentiated distance-based charging encourages the most efficient transport choice for a given trip, time-based vignettes and vehicle taxes represent sunk costs to the user, and thus do not incentivise travelling shorter distances. As such, vignette systems are convenient for the heaviest road users, while at the same time may discriminate against the occasional user. Vignettes and circulation taxes are by nature very similar instruments, which is a potential concern when Member States replace taxes by vignettes, as this can lead to compensating national users and discrimination against foreign users. The result is an uneven playing field in freight transport.

6.1. Uneven playing field in freight transport

The initial aim of the Eurovignette Directive was to eliminate distortion of competition in the road haulage market through a harmonisation of levy systems and the establishment of fair mechanisms for charging infrastructure costs to hauliers.[65] However, as demonstrated by the evaluations referred to in section 1.3, in spite of the framework provided by the Directive, the patchwork of charging systems (see Annex 5) are causing an uneven playing field. In addition, contradictory price signals stemming from the use of different systems, in particular time-based schemes, cannot ensure truly proportionate pricing.

Another source of inconsistency in road pricing is the diverging level of annual **vehicle taxes** across Europe. While Directive 1999/62/EC sets minimum levels for HGV taxes, there is no upper limit, which can result in differences of over 250% between neighbouring countries[66]. Where annual circulation taxes are meant to be a contribution to the maintenance of the national/local road network, Member States might be reluctant to implement road charging on the top of the taxes or will want to compensate their haulage sector. This can be problematic in the case of introducing a vignette scheme working as an extension of the tax to foreign operators; and raise concerns of discrimination especially in case of one-to-one compensation of nationals (see e.g. the case of the heavy vehicle fee introduced by the UK).

As a result of these variations, road charging and vehicle taxes make up a very different share of operating costs of a HGV in different Member States, as shown in Figure 6-1: Taxes, charges and tolls per standard haul, [Euro per trip]. Differences in road charges to be paid can be over 20 or even 40 euro per trip between neighbouring Member States[67]. Previous evaluation showed that the share of road user charges compared to total HGV operating costs can vary between 1% and 15% between counties applying vignettes and those using distance-based tolls (Figure 6-2). The majority of stakeholders, in particular transport undertakings

[64] I.e. satellite positioning (GNSS) or microwave communication (DSRC)

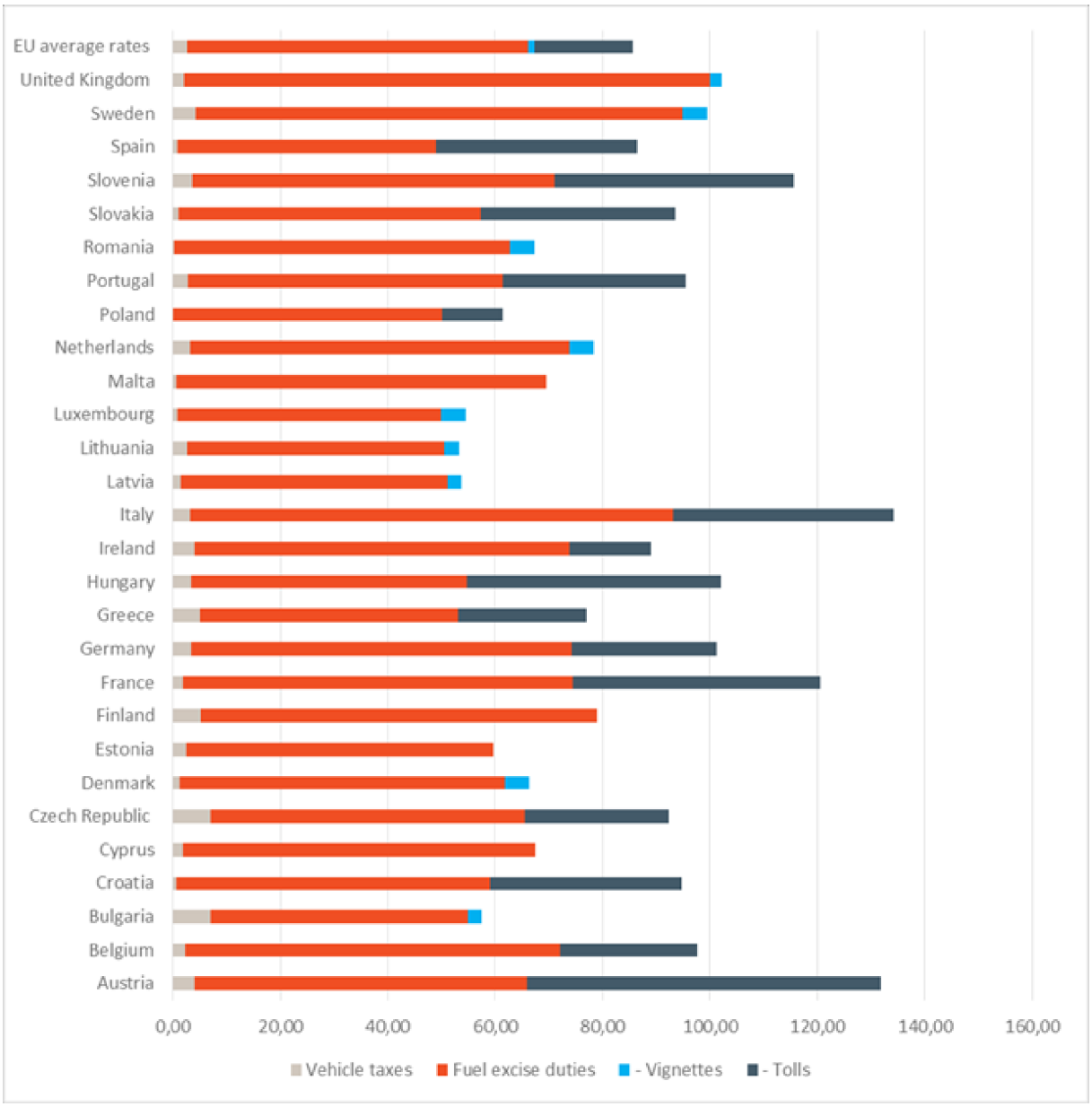
[65] Recital 1 of Directive 1999/62/EC

[66] Report in accordance with Article 11 (4) of Directive 1999/62/EC, Inventory of measures to internalise external costs, Summary of measures that internalise or reduce transport externalities, SWD(2013) 269 final: https://ec.europa.eu/transport/sites/transport/files/themes/sustainable/doc/swd%282013%29269.pdf

[67] E.g. between Belgium and the Netherlands, which can lead to distortions and traffic diversion between Belgian and Dutch ports

(82%) felt that different taxes and charge systems cause market distortion, therefore supporting EU harmonisation.

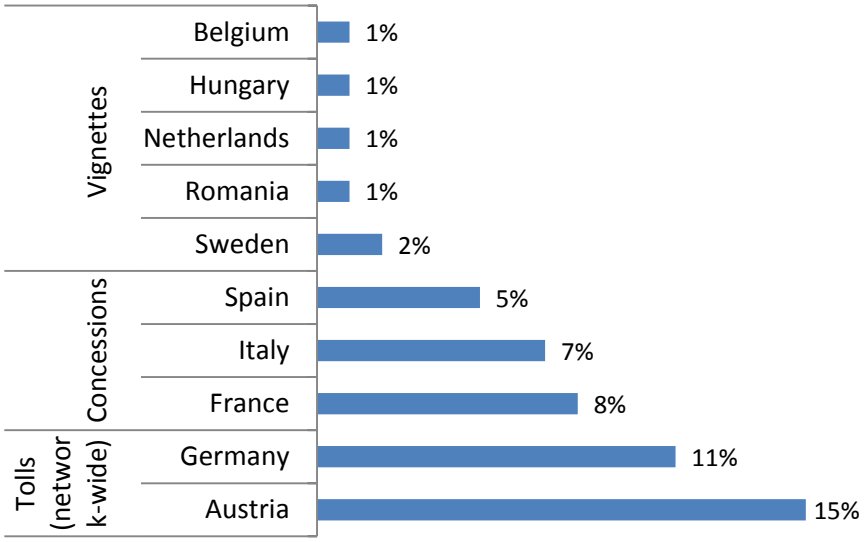
Figure 6-1: Taxes, charges and tolls per standard haul, [Euro per trip][68]



Source: COWI (2016), Assessment of Infrastructure Costs Calculation, Tolls Calculation and Variation for Heavy Goods Vehicles in Member States

[68] assuming a standard haul of 400 km

Figure 6-2: Share of road user charges compared to total HGV operating costs[69]



Source: Ricardo-AEA et al., Evaluation of the implementation and effects of EU infrastructure charging policy since 1995, 2013. Bayliss (red) Report of the High Level Group on the development of the EU road haulage market, 2012.

[69] Note that Belgium and Hungary have introduced network-wide distance-based tolling for HGVs in 2016 and 2013 respectively, which would bring these Member States closer to Germany and Austria, in the lower part of the figure. This also results greater differences in road charges to be paid between neighbouring Member States (Belgium/Netherlands and Hungary/Romania), which can lead to distortions and traffic diversion, e.g. between the ports of Belgian and Dutch ports.

7. ANNEX 7: VIGNETTE PRICES FOR LIGHT DUTY VEHICLES

Figure 7-1: Vignette prices for light duty vehicles across Member States, 2017

Member State	Vignette prices [€]		Ratio of average daily price between shortest term and longest term vignette
	Shortest term vignettes (number of days)	Annual vignette (number of days)	
Passenger cars			
Austria	8.9 (10)	86.4 (365)	3.76
Bulgaria	8 (7)	50 (365)	8.34
Czech Republic	11.5 (10)	55.5 (365)	7.54
Germany (planned)	From 2.5 to 20	From 0 to 130	3.65 to 7.3*
Hungary	9.5 (10)	138 (365)	2.53
Romania	3 (7)	28 (365)	5.59
Slovakia	10 (10)	50 (365)	7.30
Slovenia	15 (7)	110 (365)	7.11
Vans			
Austria	8.9 (10)	86.4 (365)	3.76
Bulgaria	8 (7)	50 (365)	8.34
Czech Republic	11.5 (10)	55.5 (365)	7.54
Hungary	19 (10)	138 (365)	5.05
Latvia	6 (1)	300 (365)	7.3**
Latvia	14 (7)	300 (365)	2.43**
Lithuania	6 (1)	304 (365)	7.20**
Lithuania	14 (7)	304 (365)	2.40**
Romania	6 (7)	96 (365)	3.26
Slovakia	9 (10)	47 (365)	7.30
Slovenia	30 (7)	220 (365)	7.11

* Proposal not yet adopted. In the case of the cleanest vehicles, even though the weekly *vignette would only cost €2.50, the ratio could be even higher*

** Ratio of the daily/weekly vignette price (in line with the relative price set in the Directive)

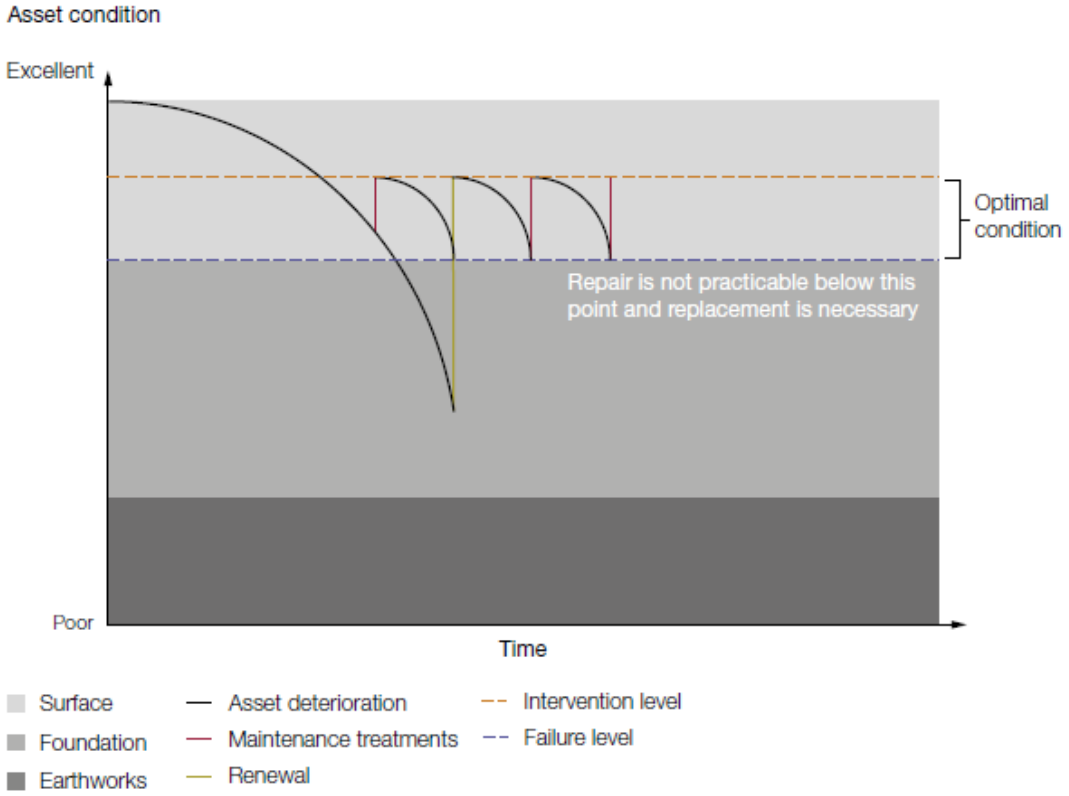
Source: own development based on analysis of data collected for the impact assessment support study

For **vans** (vehicles up to 3.5 tonnes), the picture is slightly different, with 4 Member States applying the same rates as for cars, some applying higher vignette prices than for cars, while Hungary for instance apply double rates for vans compared to cars in the case of weekly and monthly vignettes only and uses the same rate for the yearly vignette. This makes the relative price of short term vignettes for vans much less proportionate than for cars. Only Latvia and Lithuania apply the ratios set in the Eurovignette Directive for heavy goods vehicles.

8. ANNEX 8: ROAD ASSET CONDITION AND MAINTENANCE FUNDING

Figure 8-1 emphasises the point that 'optimal' road condition does not mean 'as new' but rather an acceptable condition that avoids costly replacement at a later date. Road surfaces that remain untreated can deteriorate at a faster rate, with the cost of repairs rising disproportionately – deferring preventative maintenance can therefore lead to substantial increases in repair/rehabilitation costs (European Parliament, 2014). If road condition deteriorates to the point that reconstruction is needed, the costs can be three to four times more than if timely maintenance had been adequately funded[70].

Figure 8-1 Asset Condition Model



Source: NAO, UK (2014)

8.1. Issues with road maintenance funding in Member States

Examples of maintenance backlogs are reported in several Member States – all of which currently have reports of overall good road quality:

- **Germany:** the German Institute for Economic Research (DIW) reports a past investment shortfall of almost €4 billion for the maintenance of the transport infrastructure. Assuming that at least this investment is required in order to maintain the transport

[70] https://www.piarc.org/ressources/publications/8/24531,2016R07EN-Gestion-Patrimoine-Routier-Road-Assets-Management-World-Road-Association-Mondiale-Route.pdf

infrastructure in coming years, and if the cumulative result of years of neglect is also taken into account, the additional annual investment requirement should be at least €6.5 billion (Kunert & Link, 2013)

- **UK**: a figure of €9.6 billion for clearing the maintenance backlog in local road network alone (it tends to be the local road network that has been sacrificed to preserve the strategic network). An estimated of 13 years is needed to clear the maintenance backlog (HMT, UK Treasury, 2015).
- **Ireland:** the National Road Authority has highlighted that maintenance works are most effective when carried out on a continuous basis. The Department for Transport, Leisure and Sport quantify this as an annual cost of €1.6 billion up to 2020, the current forecasted expenditure will lead to a shortfall of over €260 million in road investment. (DTTAS, 2014) (CE Delft, 2016).
- **Netherlands** the annual expenditure should be around €600 to €700 million. In the period 1995-2005, the actual expenditures were generally below the steady state level expenditures, implying an underinvestment in road maintenance. Conversely, in the period 2005-2010, expenditures were significantly above steady state levels, which suggest a recovering of overdue maintenance of national roads (CE Delft, 2016).

Another indication suggesting that the state of road infrastructure is a problem for Member States is that each year more of them realise that there is a gap in their budget for financing its maintenance (let alone development). As an example, following recommendations from the World Bank, Bulgaria plans to replace its time-based road charging scheme (bringing just over €100M/year altogether from heavy and light vehicles) with a distance-based system for HGVs, covering the entire network of roads.[71]

But road maintenance is not only a challenge in Eastern Europe. Belgium replaced its time-based charging scheme (the Eurovignette[72]) with a distance-based road charging system using satellite technology for HGVs above 3.5 tonnes on its main road network in April 2016. Germany is about to expand its distance-based tolling system applied to HGVs to all national roads (in 2018), and intends to introduce a vignette system for light vehicles, to increase the inflow of revenues that could be spend on infrastructure maintenance.

At the same time, motorists associations (FIA) and road transport operators represented by the IRU are arguing that road users already contribute more to national budgets (through taxes and charges) than what is effectively spent on road infrastructure[73, 74]. The issue is that tax revenues are generally allocated to the general budget even if those from fuel tax correspond on average to infrastructure costs (1.3% of GDP).

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[71] According to the Ministry of Regional Development and Public Works, road maintenance in Bulgaria has been severely underfunded for decades. The Bulgarian Road Infrastructure Agency estimates that the annual allocation of about €100M is less than half of the needed budget. It has also been recognized that the vignette system is not flexible enough and is not fair to users – the lion's share of revenues have come from private vehicles that cause little to no damage to the roads, while revenues from HGVs, which are the main cause of damage to the pavement, forms a small share.

[72] The Eurovignette is a road user charge for HGVs with a gross vehicle weight of minimum 12 tonnes that continues to be applied by Denmark, Luxemburg, the Netherlands and Sweden: https://www.eurovignettes.eu/portal/

[73] http://www.fiaregion1.com/en/fia_region_1/news/european-motorists-deserve-a-betterdeal.htm

[74] https://previouswww.iru.org/en_policy_co2_response_transporttax

9. ANNEX 9: SCOPE OF AND REVENUES FROM ROAD CHARGING IN MEMBER STATES

Figure 9-1: Scope of infrastructure charging systems for HGV network – Share of main network that is being tolled

Member State	Total motorway length (km)	Share of motorway that is charged for HGVs*	
		Time OR distance-based	*of which Distance-based (i.e. tolls)*
Austria	2,185	100%	100%
Belgium	1,763	100%	100%
Bulgaria	734	100%	0%
Croatia	1,290	100%	100%
Cyprus	257	0%	0%
Czech Republic	3,404	42%	42%
Denmark	1,216	100%	0%
Estonia	140	0%	0%
Finland	810	0%	0%
France	11,560	79%	79%
Germany	12,949	100%	100%
Greece	1,558	100%	100%
Hungary	1,180	100%	100%
Ireland	897	39%	39%
Italy	6,751	89%	89%
Latvia	1,674	90%	0%
Lithuania	1,948	87%	0%
Luxembourg	152	100%	0%
Malta	163	0%	0%
Netherlands	2,678	100%	1%
Poland	1,552	100%	100%
Portugal	3,065	96%	96%
Romania	683	100%	0%
Slovenia	1,499	40%	40%
Slovakia	1,943	100%	100%
Spain	14,981	23%	23%
Sweden	2,088	100%	1%
United Kingdom	3,760	100%	1%
Total	**82,880**	**76%**	**58%**

Notes: * some Member States may apply exemptions (e.g. for HGVs below 12t) or base their system on vehicle characteristics other than weight (e.g. number of axles or vehicle height).
Source: Impact assessment support study

Figure 9-2: Revenues from road charging and their use

Member State	Part of the charged network[(1)]	Annual Toll revenue / M€, 2014		Use of revenue
		HDV	LDV	
Austria	1	1235	449	Reinvested in construction, operation and safety of highly advanced road network.
Austria	2	155		
Belgium	1	650	N/A	The Flemish minister for mobility has stated that toll will be earmarked for investment in road infrastructure. The rest of the income will go to the general budget and can be spent on whatever the Flemish government so choose. The Wallonia region has not published any plans on how they are to spend the money raised from the toll but it is assumed to be reinvested into road infrastructure due to how the road management is structured there.
Bulgaria	2	102		The vignette revenues are entered in the budget of the country and are allocated to the operation, current maintenance, repair and reconstruction works, but are not meant for new construction works.
Croatia	1	317		Toll collection revenues are used to finance, build, maintain, operate and improve the motorways.
Czech Republic	1	360		All revenues from highway and motorway tolls are received by the State Infrastructure Fund, which also collects revenue from the road tax, consumer tax on hydrocarbon fuels, and the transfer of assets from the National Property Fund (privatisation). Revenues are used to finance: - Construction, modernisation, of roads, motorways, railways and inland waterways. - Repair and maintenance of roads, motorways and railways - Safety accessibility to persons with restricted movement and orientation - Construction and maintenance of cycling paths.
Denmark	2	559		Finance the upgrade of Danish hinterland connections. Toll revenues received from bridges are used to finance the operation and maintenance, as well as repay loans incurred during the construction period.
France	1	9390		Toll revenues are the main financers of the transportations infrastructures. Tolling revenues are collected on the oldest sections in order to finance the most recent ones.

Member State	Part of the charged network[1]	Annual Toll revenue / M€, 2014	Use of revenue
Germany	1	4370	The Bundesfernstraßenmautgesetz (BFStrMG) states that the Federal Government may use the income from the toll to cover the costs of operating and monitoring the toll system and for the administration costs of the Federal Traffic Infrastructure Finance Company (VIFG). In addition, up to EUR 450 million are used to implement Federal programmes aimed at securing jobs and qualifications and at promoting environment-friendliness and safety as regards haulage firms operating on toll routes. There are three programmes: to encourage the purchase of low-emission HGVs, to promote basic and further training, qualification and employment in haulage firms with HGVs, and to promote safety and the environment in haulage firms with HGVs. The remaining toll income will, apart from an annual amount of EUR 150 million, be added to the transport budget and used in its entirety for the sole purpose of improving the infrastructure of the Federal trunk roads.
Greece	1	495	Until 2007 the toll system was run by TEO, which is owned by the Government. The revenue was used to finance, maintain and operate the network. Since then, a concession system has been introduced for the majority of tolled roads. Toll charges are used to finance part of the construction, as well as maintenance and improvement of the highways. Their profits are subject to VAT, which goes to the general budget.
Hungary	1	678	The utilisation of the increased revenue due to the introduction of the HU-GO system is determined by the requirement system of the EU: it can only be used in the public road and traffic sector. Hu-Go states that the toll revenue will ensure financial means for developing, maintaining and operating the road network.
Ireland	2	217	Major new road developments in Ireland are funded through Public Private Partnerships. Therefore, the toll revenues go both to the private companies who invested in the road as well as the public sector. There is no mention on how the toll revenues that go to the public sector are distributed.
Italy	1	5454	There are no specific funds directed toward financing national highway infrastructure in Italy, which is funded by the general revenue. Highway revenue is generated by taxes and tolls, but this revenue is not tied to highway construction. A percentage of revenue generated by tolls goes to the National Autonomous Roads Corporation (Azienda Nazionale Autonoma delle Strade, ANAS) for monitoring highways under

Member State	Part of the charged network[1]	Annual Toll revenue / M€, 2014		Use of revenue
				concession.
Latvia	1	N/A	N/A	Maintenance and development of roads.
Lithuania	1	43	N/A	Financing of the road construction and maintenance, as well as Development Programme of the Republic of Lithuania.
Luxem-bourg	1	3	N/A	Luxembourg applies the principle of the unity of the budget. Revenue feeds into general taxation budget. Therefore, no revenue may be provided with an "earmarking".
Netherlands	2	28		The Netherlands funds state highways through a national Infrastructure Fund, which is fed by express lane fees and regular tolls. Provinces, municipalities, and district water boards may also set tolls on motor vehicles passing through certain tollgates on state-managed roads. Additionally, the government applies one-time and recurrent taxes on registered motor vehicles, and levies fuel taxes and a general VAT of 21%. Whether or not these taxes are applied to road construction and maintenance is unclear.
Poland	2	209 on A2 and A4		Poland stopped using the vignette system on 1st July 2011, and replaced it with a toll. The revenue is directly transferred to the National Road Fund and reinvested to the road network.
Poland	2	284	N/A	
Portugal	1	915 (for 19 toll domains)		The revenue from tolls is directly assigned to a legally independent entity in charge of financing, building, maintaining, and operating the infrastructure. Profits are also subjected to company taxes and VAT and therefore contribute to the national budget.
Romania	1	N/A	N/A	Toll revenues are allocated directly to NCMNR. In addition, NCMNR (Road Administration) collects charges for overloaded vehicles. The total direct income, however, is too low in relation to the full cost of road maintenance for the national road network. Thus, NCMNR is reliant on the State budget, IFIs and/or commercial loans in order to fund the shortfall.
Slovenia	2	350		Motorways are operated by DARS, a company that is 100% owned by the State. The revenues are used to finance motorway management and maintenance, construction of new motorways and repayment of loans.
Slovakia	1	185	119 .6	Construction and maintenance of roads.
Spain	2	1709		Concessionaires are responsible for financing, building, maintaining, and operating the infrastructure for Spanish toll motorways. Their profits are subject to VAT, which goes to the general budget.

Member State	Part of the charged network[(1)]	Annual Toll revenue / M€, 2014		Use of revenue
Sweden	1	N/A	N/A	Concerning bridges between Sweden/Denmark and Sweden/ Norway, the fees are meant to cover the cost of building and maintaining the infrastructure. At Öresundsbron, Sweden and Denmark divide the toll revenues 50/50. At Svinesundsförbindelsen, Sweden collects tolls from vehicles entering Norway.
United Kingdom	1	49.28	N/A	The revenue raised from the HGV levy goes into general government funds.
United Kingdom	2	102		Any revenue generated from tolls goes to the highway authority and must be used for the road network or related transportation measures.

[1] *1= network-wide (or large parts), 2=specific parts of the network (e.g. specific bridges, tunnels etc.)*

10. ANNEX 10: LEVELS AND DIFFERENTIATION OF ROAD CHARGES

Figure 10-1: Average user charge per km on toll roads across EU Member States (freight transport)

Member State	Charging system and average charge per vehicle category in Cent/Km					
	HGV > 12t	Charge /tolled km	HGV < 12t	Charge / tolled km	Vans < 3.5t	Charge/ tolled km
Austria	Distance-based	46.7	Distance-based	32	Time-based	-
Slovenia	Distance-based	27	Distance-based	21.4	Time-based	2.3
France	Distance-based	26.5	Distance-based	21.5	Distance-based	13
Spain	Distance-based	22.4	Distance-based	20.8	Distance-based	11.7
Ireland	Distance-based	20	Distance-based	18	Distance-based	12.2
Croatia	Distance-based	20	Distance-based	16	Distance-based	11
Hungary	Distance-based	19	Distance-based	11.7	Time-based	2.5
Portugal	Distance-based	18.5	Distance-based	15	Distance-based	13
Belgium	Distance-based	18.4	Distance-based	12.5	N/A	0
Czech Republic	Distance-based	18.2	Distance-based	11.5	Time-based	1.3
Slovakia	Distance-based	17.7	Distance-based	7.7	Time-based	1.3
Germany	Distance Based	16.2	Distance-based (only above 7.5t)	3.5	N/A	0
Italy	Distance-based	13.2	Distance-based	10	Distance-based	7
Greece	Distance-based	11.1	Distance-based	9.2	Distance-based	3.4
Poland	Distance-based	10.6	Distance-based	7.8	Distance-based	10
Romania	Time-based	3.3	Time-based	1.1	Time-based	3.1
Sweden	Time-based *	3	N/A	0	N/A	0
Denmark	Time-based *	2.8	N/A	0	N/A	0
Latvia	Time-based	2.4	Time-based	1.5	Time-based[75]	-
Luxem-bourg	Time-based *	2.3	N/A	0	N/A	0
Lithuania	Time-based	2.2	Time-based	1.6	Time-based	-
Bulgaria	Time-based	2	Time-based	1.2	Time-based	2.1
Netherlands	Time-based *	1.9	N/A	0	N/A	0

[75] Since 1 January 2017 for vehicles with a total permissible weight of more than 3 tonnes

United Kingdom	Time-based [76]	1.3	N/A	0	N/A	0
Cyprus	No charging	0	No charging	0	No charging	0
Estonia	No charging	0	No charging	0	No charging	0
Finland	No charging	0	No charging	0	No charging	0
Malta	No charging	0	No charging	0	No charging	0

Figure 10-2: Comparison of EURO emission groups across EU Member States (where applied)[77].

	COUNTRY	EURO 0	EURO I	EURO II	EURO III	EURO IV	EURO V	EEV	EURO VI
Time-based	**Denmark, Luxemburg, Netherlands, Sweden**	**Group1**	**Group2**	Group3					
	Bulgaria	**Group1**				**Group2**			
	Lithuania	**Group1**				**Group2**			
Distance-based	**Austria**	**Group1**				**Group2**		Group3	Group4
	Germany	**Group1**			**Group 2**	Group3	Group4		
	Poland	**Group1**			**Group 2**	Group3	Group4		
	Czech Republic	**Group1**			**Group 2**		Group3		
	Slovakia	**Group1**			**Group 2**	Group3			
	Slovenia	**Group1**			**Group 2**	Group3			
	France/Italy Frejus tunnel	Not allowed	**Group1**		**Group2**				
	France/Italy Mont Blanc tunnel	Not allowed			**Group1**				

Source: Ricardo-AEA et al., Evaluation of the implementation and effects of EU infrastructure charging policy since 1995, 2013

[76] HGV Levy is applied to 11 vehicle categories depending on the weight (always > 12 t) and the number of axles. For most UK-registered HGVs, vehicle excise duty (VED) was reduced by the same amount as the levy, and is conveniently paid alongside VED to keep administrative costs to a minimum. As with VED the levy can be paid either annually or six-monthly. The tax disc will display the total duty paid (combined vehicle tax and levy). Vehicles registered abroad must make levy payments before entering the UK. The levy can be paid by day, week, month or year and discounts are available for longer levy periods.

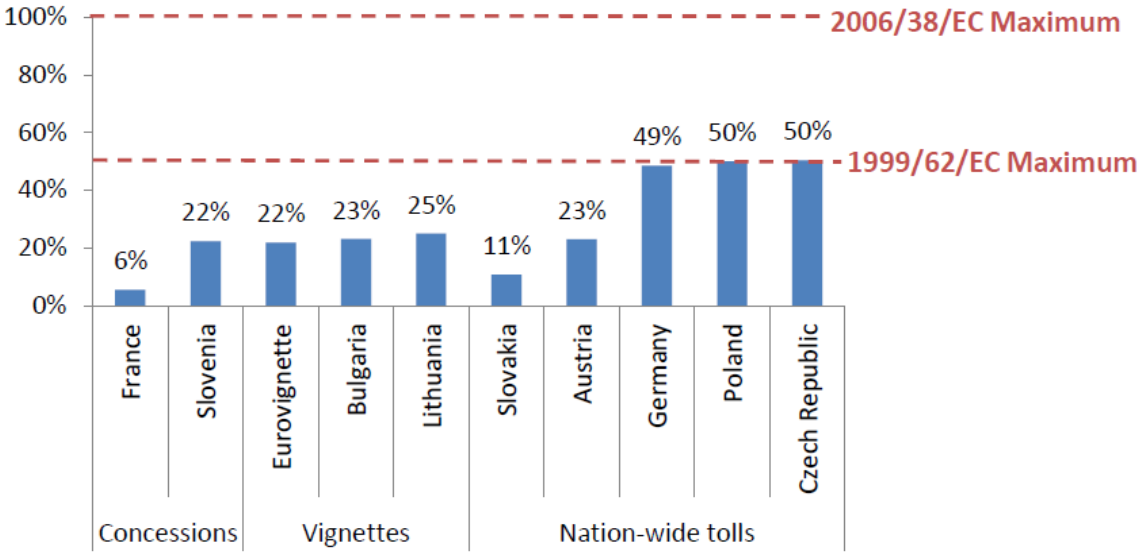
[77] Existing concession contracts are exempted from this requirement until the contract is renewed (article 7g (1) of Directive 1999/62/EC, as amended).

Figure 10-3: Differentiation by EURO class for vehicles >12t.

Member state	Date of toll introduction	Date of first differentiation by Euro class	Dates valid	Vehicles	Saving compared to Euro I				
					Euro II	Euro III	Euro IV	Euro V	Euro VI
Germany	2005		2005	>12t	15%	15%	30%	30%	n/a
			2006-2008	>12t	0	17%	17%	30%	n/a
Czech Republic	2007		2007-2010	>12t	0	17%	17%	30%	n/a
			2012	>3.5t	0	21%	21%	50%	50%
Austria	2004	2010	2010	>3.5t	0	0	13%	13%	18%
Poland	2011		2011		0	13%	30%	50%	50%
Slovakia	2010		2010		0				
			2012 (highways)	>12t	0	5%	30%	30%	30%
			2012 (1st class roads)	>12t	0	7%	7%	7%	7%
			2012 (highways)	3.5-12t	0	8%	11%	11%	11%
			2012 (1st class roads)	3.5-12t	0	10%	10%	10%	10%

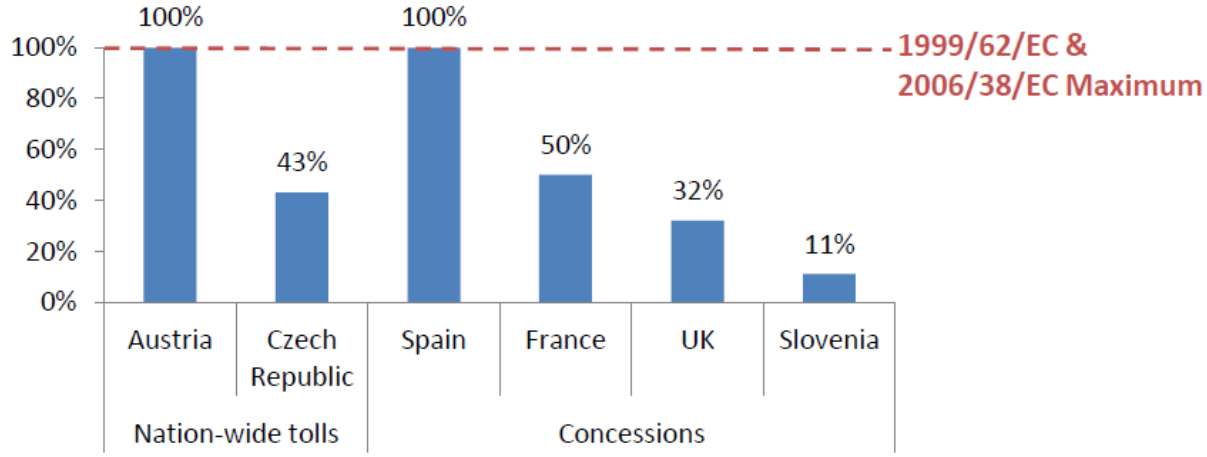
Source: Ricardo-AEA et al., Evaluation of the implementation and effects of EU infrastructure charging policy since 1995, 2013

Figure 10-4: Maximum charge differentiation according to Euro class for vehicles in the same category



Source: Ricardo-AEA et al., Evaluation of the implementation and effects of EU infrastructure charging policy since 1995, 2013

Figure 10-5: Maximum differentiation according to time of travel for vehicles >3.5t in the same category[78]



Source: Ricardo-AEA et al., Evaluation of the implementation and effects of EU infrastructure charging policy since 1995, 2013

[78] It should also be noted that in most countries the differentiation is only applicable on selected routes, whereas Czech Republic and Slovenia apply them on the network. In addition, Austria and Slovenia apply higher charges at night to control noise emissions, whereas the other Member States apply higher charges during peak hours to control congestion.

11. ANNEX 11: PRE-SELECTION OF POLICY MEASURE AND PACKAGING OF OPTIONS

The packaging of measures is done in a way to ensure that all options address the identified problem, at least to some extent. The minimal solution to each problem is PO1. Some of the measures can address more than one problem.

11.1. Rationale behind retained measures

To contribute to the goals of low-emission mobility:

- Promoting zero-emission vehicles through allowing reduced toll rates (for both HDVs and LDVs): this is a measure, which is very easy to implement while providing a direct price signal to users; it does not require emission values to be measured and is technology neutral. Since the total cost of ownership of a zero-emission HDV is still 2 to 3 times that of a conventional diesel, even complete exemption from charges could be justified for these vehicles. The situation is different for LDVs, where the total cost of ownership is already very close (see section 4.2.10 of the impact assessment support study) and even a more limited reduction of road charges could provide incentives for the uptake of clean vehicles.
- Mandatory differentiation of infrastructure charges according to CO_2 emissions for HDVs (HGVs + buses/coaches) from 2020: Once vehicle certification data on CO_2 emissions becomes available for new vehicles[79], it will be possible to differentiate charges between the more and less fuel-efficient trucks. Distinction could be made between i) Euro 0-VI vehicles, ii) low-CO_2 (new or retrofitted) vehicles. Since the certification data will only be available in the future, the precise method for differentiating charges would be defined by the Commission in a delegated act. In order to provide a coherent price signal and have noticeable impact, Member States would be required to differentiate tolls accordingly. Differentiation between Euro 0-VI and new low-emission vehicles should be simple (in any case much simpler than the current differentiation according to Euro classes applied by Member States) remain revenue-neutral, in recognition of the fact that the cost of CO_2 emissions are in practice internalised through fuel taxation (even if excise duties are not necessarily collected with this goal in mind). A possible way in which such modulation could take place is described in Annex 4 (Figure 4-9).
- Mandatory differentiation of tolls and user charges (i.e. both distance- and time-based) for LDVs (Vans and passenger cars) from 2020: Distinction would be made into 3 or 4 emission classes based on WLTP[80] according to CO_2 and pollutant emissions, complemented by RDE tests for NO_X. In order to provide a coherent price signal and have noticeable impact, Member States would be required to differentiate tolls accordingly.

  Compared to LDVs with a gasoline engine, diesel LDVs generally have lower emissions of CO_2 but higher emissions of air pollutants. Therefore, incentivising only

[79] VECTO – Vehicle Energy consumption Calculation Tool developed by DG CLIMA and the JRC – will be ready to provide this information for HGVs above 7.5 t as from 2019.

[80] World harmonised Light vehicle Test Procedure

the most fuel-efficient LDVs without taking account of pollutant emissions would promote diesel driven vehicles entailing higher emissions of air pollutants and also exacerbate the problem of diesel/gasoline imbalance.

Differentiation of road charges for LDVs could be based on the forthcoming UNECE World harmonized Light vehicle Test Procedures (WLTP) complemented by on-road tests, which are better reflecting real driving emissions (RDE[81]) and allowing better comparison between petrol and diesel cars. A possible way of such modulation of charges is described in Annex 4, section 4.3.5.

To contribute to adequate road quality

- Monitoring and reporting of toll revenues and expenditures on maintenance/operation of roads will ensure transparency and raise the awareness of Member States' authorities of potential financing gaps. As an extension of current reporting requirements on tolls (every four years, including information on the levels and variation of charges, revenues from charges and any action related to their use recommended by the Directive), Member States would be required to publish annual reports in a more systematic way, including information on

    - total revenues from road charging (also for time-based systems) as well as congestion charging;
    - the use of revenues;
    - the state of roads based on objective indicators (to be harmonised in a subsequent step, cf. measure below): and
    - the level of congestion on the tolled network.

    The measure received the support of over 2/3 of the respondents to the public consultation. Because of the administrative implications, Member States are generally less supportive. It has nevertheless maintained as an alternative to the provision of earmarking of toll revenues in general, which is even less supported by Member States, and to improve the current – insufficient reporting practices. It is also worth noting that Regulation No 1108/70 already requires Member States to report on infrastructure spending but this is not coherently practiced by them (see also section 12.2.3 in Annex 12).

- Introduction of common quality indicators will ensure that the manager of a toll road will maintain the given road section in sufficiently good/safe condition. Such indicators are already used by most Member States. However, the information is not strictly

[81] For their approval, new models of vehicles are currently subject to laboratory tests of their emissions. However, analysis has shown that light vehicles produced in line with existing Euro standards generate substantially higher emissions on the road than in laboratory conditions. This problem was detected in particular in relation to emissions of diesel vehicles of the pollutant substance nitrogen-oxides (NOx). That is why new procedures to measure emissions in real driving conditions are needed. Until at least 2021, so called conformity factors will be applied to allow manufacturers adapt to RDE tests. See e.g. http://www.consilium.europa.eu/en/press/press-releases/2016/02/12-vehicle-emissions-in-real-driving-conditions-2nd-package/

comparable since different methodologies are used. A harmonised definition based on current national practices in monitoring road characteristics could be adopted by the Commission through an implementing act.

To ensure that road pricing treats occasional / non-resident motorists fairly:

- Removing the possibility to exempt HGVs above 12 tonnes after a period of 5 years will ensure that all HGVs are subject to proportionate treatment thereby contributing to levelling the playing field in road freight transport. Currently these vehicles are exempted from road charging in the Member States applying the so called 'Eurovignette' (Denmark, Luxembourg, the Netherlands and Sweden) and in the UK, while Estonia also intended to introduce its upcoming charging scheme only to vehicles above 12 tonnes. Germany applies tolls to vehicles above 7.5 tonnes. The stakeholder consultation indicated general support to this measure and finally Estonia has also decided to charge vehicles between 3.5 and 12 tonnes. Germany has also such plans.
- Inclusion of buses and coaches designed to carry at least 16 passengers (with a maximum weight above 3.5 tonnes) in the scope of the Directive and applying the same principles as to HGVs: these vehicles cause similar damage to the infrastructure and the environment as HGVs (a number of Member States already apply similar if not the same charges for all HDVs). These buses are typically used for long distance services, and regular interurban services could be further liberalised by revising Regulation (EU) 1073/2009. Since long-distance coach services compete with rail transport, it appears justified that they also pay for the use of the infrastructure and for environmental damage in a coherent way across the EU. The measure was also explicitly supported by some stakeholders saying that coaches should be the next vehicle category to be covered by common rules (to be followed by light goods vehicles and passenger cars). As in the case of extension of rules to HGVs below 12 tonnes, this measure would affect the four 'Eurovignette' countries, the UK, Germany, and Estonia, after having introduced charging for HGVs (cf. Figure 5-3 in Annex 5).
- Introducing non-discrimination and proportionality requirements for light vehicles: the goal is to ensure non-discriminatory pricing for short-term vignettes – mainly purchased by occasional users thus most often by foreign nationals – by clarifying the rules on proportionality in the case of light vehicles, taking account of different use pattern of private vehicles[82], and the rules concerning the possible compensation of nationals.

  Since short-term vignettes are mainly purchased by holidaymakers and the price of a daily vignette would have to be very low even to the point of generating a higher administrative cost than revenue brought, it would seem justified to require the provision of at least two different type of short-term vignettes: monthly (valid for 1 or 2 months) vignettes, 10-day vignettes instead of weekly vignettes (one week vignettes often oblige holidaymakers to buy two vignettes to cover the inbound and outbound trip). Most Member States already offer 10-day vignettes, while 4-day vignettes (if

[82] Private vehicles, if used regularly, are used on shorter distances than HGVs; at the same time, when they use the motorway network less frequently, the average length of the trip increases. This, and the fact administrative costs are proportionately higher in the case of light vehicles justifies somewhat higher relative price for the short-term vignettes in the case of these vehicles, compared to HGVs (for which the Directive currently limits the prices of short-term vignettes: the monthly rate at 10%, the weekly rate at 5%, and the daily rate at 2% of the annual rate – these correspond to price ratios of 1.2, 2.6 and 7.3 respectively).

available) could offer a proportionate and thus fair price for very limited use of toll roads.

Based on a dedicated study[83] using survey data from the UK, the only Member State having relevant data, the following vignette types and price ratios would be considered proportionate:

- Two-month vignette: max. 25-30% of that of the annual vignette (ratio of up to 1.8);
- Monthly vignette: max. 15-18% of that of the annual vignette (ratio of up to 2.2);
- 10-day vignette: max. 7-8% of that of the annual vignette (ratio of up to 2.9);
- 4-day vignette is max 4-6% of that of the annual vignette (ratio of up to 5.5).

The percentages are derived from the assumed quantity of trips that the holder of vignette type makes and the average km per trip, according to the assumptions of the Booz&Co. study, that is:

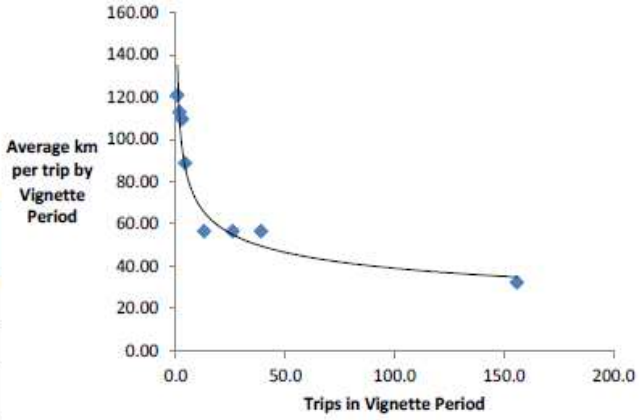
- The longer the vignette duration, the less frequently the motorist uses it (by time);

  and

- The more frequent the usage, the shorter the trip (by distance).

Figure 11-1: Average trip and distance assumptions

Vignette price by duration (€)	Trips in period assumption	Km per trip
Annual	156.0	32.2
Month	13.0	56.4
Week	3.0	109.5



Source: Booz&Co. (2012).

To reflect their more intensive use of the roads, vans and minibuses could be charged at a higher rate than private cars.

[83] Booz&Co. (2012). Study on Impacts of Application of the Vignette Systems to Private Vehicles. http://ec.europa.eu/transport/sites/transport/files/modes/road/studies/doc/2012-02-03-impacts-application-vignette-private-vehicles.pdf

The measure would primarily affect those Member States, which operate time-based vignette systems to charge passenger cars (cf. Figure 5-4 in Annex 5), and received overwhelming support from consumers/citizens, while some Member States are reluctant about it.

- Phasing out vignettes for HDVs (HGVs + buses/coaches) after 5 years (by 2023) – only distance based charging would be allowed for these vehicles. Member States would remain free to decide whether or not to introduce road charging on their territory and on which roads. However, once they decide to do so, the method of distance-based tolling would be obligatory on the roads which are charged. A 5-year implementation period would give Member States ample time to implement distance-based tolls. The common argument of Member States saying that systems costs of distance-based tolls are prohibitive would be addressed by the parallel revision of the EETS legislation, which would lead to lower system costs[84]. The measure would affect the nine Member States currently operating vignette systems for HGVs and 12 applying vignettes or no charging to buses/coaches (cf. Figure 5-1 and Figure 5-3 in Annex 5). While some Member States that currently apply vignette schemes are not in favour, the majority of stakeholders agree that this is a necessary next step in the harmonisation of charges.
- Removing minimum levels of vehicle circulation taxes for HGVs above 12 tonnes (Chapter II of the Directive) would allow Member States reduction or complete abolishing of the tax in case of the application of distance-based charging on TEN-T network. Those Member States which are introducing new systems are interested in being able to compensate the haulage sector through the reduction of vehicle taxes, as the parallel application of an annual vehicle tax and road charging can be perceived as double taxation. Many stakeholders also stressed that any increase in costs as a result of increased charges should be compensated for by reductions in other transport-related taxes.
- Phasing out vignettes for vans – only distance based charging would be allowed for these vehicles: since light goods vehicles (vans) are more and more engaged in international transport[85] and compete with HGVs, it can be argued that these vehicles should also be required to pay tolls according to the actual use of the roads (instead of the relatively cheap time-based charges). This would further the creation of a level-playing field in freight transport. The measure would affect nine Member States currently applying vignettes for these vehicles (cf. Figure 5-2 in Annex 5). While road transport operators and environmental organisations are in favour of the measure, Member States are less inclined to agree with it. It would nevertheless be a logical future step in the application of the polluter pays and user pays principles.

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[84] It is possible already now for Member States to implement distance-based solutions that are not prohibitively costly. For example the Hungarian system introduced in 2013 allows the use of third party devices, including existing fleet management equipment, as on-board units (OBUs) necessary for keeping track of the kilometres covered by the vehicle

[85] See e.g. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/514912/road-use-statistics.pdf or the results of the consultations carried out in the framework of the impact assessment on the revision of Regulation (EC) No 1071/2009 and Regulation (EC) No 1072/2009, where stakeholders representing the EU road haulage industry (IRU) and national level (France, Germany, and Denmark) referred to an increasing presence of foreign registered LCVs in hire-and-reward traffic

- Phasing out time-based vignettes for cars: distance-based pricing is the most proportionate way to charge user for the costs of road use. It can be modulated according to the environmental performance of vehicles as well as location and the time of travel, and minimises the possibility of discrimination on the basis of travel frequency (discounts may still be offered by toll chargers on a commercial basis). The measure would affect the seven Member States currently applying vignettes for passenger cars, plus Germany, which plans to introduce such a system (cf. Figure 5-4 in Annex 5). As for vans, there is a distinct difference in stakeholder views concerning this measure. However, a number of Member States would be against it as the measure affects private cars, which makes it much more sensitive. It should be part of a medium-term strategy (as already put forward in the 2011 White Paper), but in the short run, it should be treated with care.

To contribute to reduction of air pollution and congestion:

- Simplification of the requirements for external cost charging: merging the charging of noise costs (which are very low on their own) with the cost of air pollution and the waiver of the notification requirement, in case the values set in the Directive are applied, will make it significantly easier for Member States to apply external cost charging. The revised Directive could offer a set of reference values for external cost charges to be applied to different HGV and bus/coach categories depending on their weight or number of axles. These values would better reflect the actual amount of external costs generated by heavy duty vehicles and Member States would not need to make any calculation unless they intend to apply higher charges than the new reference values.
- Extending the possibility to use mark-ups beyond mountain regions (up to 15% on top of average infrastructure charge, and up to 25% in case of cross-border sections) to contribute to the financing of removing bottlenecks on the TEN-T network, while keeping the condition of acute congestion or significant environment damage generated by vehicles. The measure would apply to HGVs and buses/coaches.

  Member States would not be allowed to apply a mark-up on roads on which a congestion charge is already applied. Mark-ups could be used for example where no genuine congestion charging is possible (e.g. because cars are not subject to distance-based charging).

- Phasing out differentiation of infrastructure charges for HGVs according to Euro emission classes (simplification) – with external cost charging remaining optional. The removal of a redundant measure could incentivise Member States to make use of the other, now simplified, possibility of using external cost charging to protect their local environment from pollution caused by older vehicles. In any case, differentiation according to Euro emission class is losing its relevance and effectiveness over time as the vehicle fleet is replaced and without a Euro VII standard in sight. The share of Euro VI vehicles on German toll roads increase by about 16% each year and stands already at 47% overall and 51% among vehicles registered in Germany, representing a replacement rate of just over 6 years. Thus, the share of Euro 0-IV is barely 6% and decreasing every year. The tendency is similar in other countries operating network-wide distance-based tolls; e.g. in Hungary the share of toll paid by Euro VI trucks

increased from 12 to 21% between 2015 and 2016, with the share of Euro V standing at 50%. The pace of the change is at least partly due to the fact that Hungary does not differentiate between Euro III, IV, V and VI, which also explains that the share of tolls paid by Euro II-III trucks was still 20% in 2016 (but dropped from 28% in 2015). These trends, together with the fact that Member States with long-term concession contracts have been exempted from this differentiation indicate that in just a couple of years the measure will have no impact, apart from hindering genuine external cost charging.

- Allowing genuine congestion charging on top of the infrastructure charge on congested parts of the network, for all vehicles (LDVs + HDVs): such a congestion charge, should Member States decide to implement it, would apply to all vehicles (LDVs and HDVs), which is the fairest way to charge as they are all contributing to congestion. Congestion charging is only possible in a distance-based scheme. Therefore, where private cars are not subject to tolls (when they either use the roads freely or are subject to a vignette scheme), genuine congestion charging cannot be applied.

  It would be up to the Member State to choose whether to make use of this possibility or not. The Directive could require the revenues generated by congestion charging to be invested in the maintenance/development of the road in question or alternative solutions. This could raise the level of acceptability of an extra charge.

  While Member States generally want to keep the decision on the use of toll revenues for themselves; however, they did agree to the requirement of allocating revenues from specific additional charges to transport in the case of mark-ups (plus external cost charges if applied in combination). Since congestion charging would also only cover limited stretches of the network only at specific hours of the day or days of the year, the collected amounts would be limited compared to overall toll revenues. The measure might have therefore better chances of success than the obligation of generalised earmarking.

  In the case of congestion charging many fear that this would become an additional burden on those who are already stuck in congestion. Allocating the revenues to projects addressing the problem can improve acceptability as it could render the charge progressive. As described in the impact assessment support study, whether congestion pricing has progressive or regressive effects depend on the design of the system and on initial travel patterns – and most crucially, on the use of revenues[86].

  Member States are likely to face opposition to introduction of congestion charges if the scheme is perceived to be inequitable. The revenues can be used to counteract any regressive impact, which is a key factor in the acceptability of the systems – hence it is likely that any new congestion charge introduced under the policy options will be (perceived as) equitable, otherwise they will be rejected by the public.[87]

[86] Ricardo et al. (2017), Support Study for the Impact Assessment Accompanying the Revision of Directive 1999/62/EC.

[87] Ibid.

- Making external cost charging mandatory on the tolled TEN-T network for all heavy-duty vehicles: with the phasing out of differentiation according to Euro class, it can be argued that the pollutant emissions of vehicles would have to be factored in the road charge if Member States are still to incentivise (not only more efficient) but also cleaner HDVs. In practice, where HDVs are charged, the toll would have to include an external cost charge. Member States would still have the possibility to charge only a percentage of the reference values to be provided in the Directive.

11.2. Discarded policy options (measures)

Some of the specific measures of a full internalisation scenario were considered during the public consultation but have not been retained:

- **Making distance-based charging mandatory on the TEN-T network for HGVs / all goods vehicles** – not retained due to extensive implementation costs (at least in the short term) and proportionality considerations. Road charging is a very sensitive issue for Member States, especially when it comes to passenger cars. While this would probably be the most effective solution to the identified problems, it is not achievable at this stage. In addition, in sparsely populated areas it may not be the most efficient solution (due to the relative importance of costs compared to traffic volumes).

  The consultation results clearly indicate negative sentiments about such a restrictive measure among those Member States which have no distance-based charging in place. Even other stakeholders, which are in favour of such a measure to be applied on the TEN-T network as the ultimate long-term goal, indicated that this needed to be phased in gradually.

  For heavy goods vehicles, all Member States (except Estonia, Finland, Cyprus and Malta) already have charges in place (either tolls or vignettes). The impact of mandatory charging would therefore be limited, while creating strong political opposition. Considering that most countries have charging in place, it would be more effective to require Member States to abandon time-based charging and apply tolls.

- **Inclusion of the external costs of accidents not already covered by insurance schemes** (supported by the European Parliament) – not retained because accident costs are best internalised through pay-as-you-drive insurances and taxes thereon; road charging would not be the fairest and could only be the second best instrument. The consultation did not show practically any support for including accident; on the contrary, a number of respondents mentioned insurance schemes as a better instrument.
- **Mandatory application of genuine congestion charging on congested parts of the network in peak hours for HGVs / all vehicles** – not retained due to extensive costs as it would require setting up tolling systems to cover the relevant parts of the network to facilitate such charging, and imposing it on Member States would raise subsidiarity considerations. The consultation did not show support for this measure, even among those who generally supported congestion charging, instead saying that the decision should be left with Member States.

The option of full internalisation would also mean that Member States would have to apply generalised distance-based charging for passenger cars. Even though with the evolution of intelligent transport solutions (in-car and roadside) pay as you drive schemes will no doubt gain relevance, making it mandatory at this stage would face strong opposition. The use of such systems has to be made easier and more attractive to the user first on a voluntary basis to raise public acceptance.

Other considered and discarded measures:

- **Awarding discounts for the use of specific fuel-saving equipment, such as low-resistance tyres of aerodynamic devices** in order to incentivise more efficient operations (also applicable to the existing vehicle fleet) – not retained due to difficulties in monitoring and enforcement – the presence of the given equipment would have to be tracked via the on-board unit of the vehicle either automatically or with manual intervention from the driver.
- **Promotion of specific low carbon fuel** technologies – not retained because it would require complex calculations of specific emissions attributed to the different technologies to ensure a technology neutral approach. Over time, this will be possible with the use of the VECTO tool (PO2), while the promotion of zero emission vehicles does not require such a methodology and is foreseen already in PO1.
- **Introduction of rules on the liability of the keeper of a toll road to maintain the given road section in sufficiently good/safe condition**. Even though the measure received almost as much support from respondents to the on-line public consultation as the monitoring and reporting requirements, it would effectively introduce a legal obligation to ensure that the objective of achieving fair road quality is met. The option has been discarded as it was considered not to respect subsidiarity requirements. Stakeholders that were interviewed did not support attempting to improve road maintenance by way of rules relating to the potential liabilities. They suggested that liability issues are best dealt with at Member State level and that setting out some general indicators focused on minimum standards at EU level was more appropriate.
- **Making it possible to apply genuine congestion charging (i.e. on top of infrastructure charges) on congested parts of the network in peak hours for <u>HGVs only</u>** – not retained because this solution would unfairly treat freight transport and would not be the most effective since about 80% of road congestion can be attributed to light vehicles.
- **Mandatory earmarking (ring-fencing) of revenues from road charging** – as indicated in Figure 9-2 in Annex 9, Member States already allocate at least part of the revenues from road charging to transport (in some cases specifically to road maintenance). However, they want to keep the decision on the use of revenues from road charging in general at their own discretion. The measure has already been proposed but was rejected by Member States and based on the consultation results, even though road users would welcome such a provision, the majority of Member States would still reject it. It is therefore not currently achievable.
- **Requiring Member States to prepare national plans on the maintenance and upgrade of their road networks** (as an alternative to mandatory earmarking, which has already been proposed twice by the Commission but which failed for reason of subsidiarity) – not retained due to proportionality considerations; discarded in favour of a

similar reporting measure that would be less burdensome on Member States (i.e. the option to monitor and report toll revenues and expenditures).

12. ANNEX 12: ASSESSMENT OF MEASURES AIMED IMPROVING ROAD QUALITY

The two retained measures following the first screening of options are A) Monitoring and reporting by Member States through **regular infrastructure reports,** and B) Introduction of **quality indicators** for tolled roads. The measures were analysed individually and in combination, and can be applied together with any of the policy options identified in section 5. The main impacts are described below while a full assessment can be found in the impact assessment support study.

12.1. Impacts on road quality

The main intended impact of both measures A and B is to improve road quality. This is the key impact as all other impacts will depend on the extent to which road quality may change as a result of applying any of the two measures.

Measure A – **monitoring and reporting on revenues and expenditures** – works through (1) greater transparency allowing increased public awareness of the costs of road maintenance and acceptance of road tolls, the uptake of such schemes and thus potentially increased revenues. Reporting will improve understanding and help Member States (2) identify financing gaps before the problem exacerbates and ensure that the necessary resources are in effect allocated to maintenance.

(1) Previous experience following the introduction of road pricing in various countries show that transparency about the use of revenues increases the public acceptability of charging systems, especially when revenues are ring-fenced and reinvested in the transport system. At the same time, allocating revenues to the general budget is least well received by users[88]. This is also confirmed by the result of the public consultation where 82% of stakeholders agreed that the revenues generated from taxes and charges should be reinvested into the maintenance, repair and upgrade of the road network, ensuring transparency of the process to the public.

(2) Identifying any maintenance gap sooner will help improve road quality in Member States where the lack of information is the underlying issue. This appears to be the case in a number of Member States (BE, CY, DK, DE, GR, HU, MT, PT and RO) (European Parliament (2014)).

Overall, measure A is likely to have a positive effect on road quality by creating enabling conditions that improve public acceptance and contribute to better understanding of potential expenditure issues. At the same time, it is also likely that the measure on its own will not be adequate to ensure good road quality in all Member States and so it should be implemented as part of a wider package of measures.

Measure B – the introduction of a set of common **quality indicators** – on the other hand would contribute to setting minimum standards at EU level. Road infrastructure represents the largest assets in most countries and there are different well-established national approaches/indicators to assess road quality. Even where Member States apply similar

[88] Cf. various studies referred to in the detailed annex of the Impact assessment support study, including CEDR

techniques, data is often compiled and reported differently, even though the principles and core information needs are the same.

Measure B would introduce tools that can improve the effectiveness of road quality monitoring in Member States, which do not have well established procedure. The measures is likely to have a positive impact by improving the quality and comparability of information on road condition.

12.2. Main economic impacts

12.2.1. Transport costs

To the extent that measures A and B can improve road quality, they are expected to have indirect positive impact on reducing the vehicle operating costs described in section 2.1.2. According to World Bank studies, every dollar saved on road maintenance increases vehicle operating costs by 2 to 3 dollars. Overall, although it is not possible to estimate the direct effect of measures A or B on road quality, it is likely that greater improvements in road quality will result in greater benefits. Hence, it is expected that the impact of **both measures together would be stronger** due their potentially greater combined impact.

12.2.2. Impacts on SMEs

Any road transport undertaking would benefit from reduced operational costs, with micro enterprises being relatively more positively impacted than large companies due to their smaller turnover. Since 90% of the road haulage sector is composed of enterprises with fewer than 10 employees[89], most of them would feel the difference in their daily running costs. A UK study, estimated the **savings linked to vehicle operations** at EUR 16.000 per year. It is not by accident that the representatives of such undertakings are most vocal when it comes to supporting the earmarking of revenues to road maintenance (as opposed to cross-financing of other modes of transport).

12.2.3. Administrative costs

According to a regulation from 1970[90], Member States have to report road infrastructure spending, so **measure A** is not expected to generate any additional costs. In effect, that regulation has extremely cumbersome reporting requirements, which may result in its repeal, while measure A would just require a very limited and focussed set of figures, thereby resulting in a **reduced level of administrative burden** to Member States compared to the status quo.

Measure B may require additional equipment and time to monitor e.g. road surface, which in the case of sophisticated systems could entail high costs; however, recent technological development has significantly reduced the cost of measurement (Forslöf & Jones, 2015). Overall, for **measure B**, it is expected that Member States that already practice advanced

[89] Eurostat. (2017). Goods road transport enterprises, by number of employees. road_ec_entemp

[90] Regulation (EEC) No 1108/70 of the Council of 4 June 1970 introducing an accounting system for expenditure on infrastructure in respect of transport by rail, road and inland waterway

techniques will incur little or no additional costs, whereas there may be costs associated with equipment and staff time for countries that need to adopt new approaches.

At the same time, it is possible to offset any additional administrative/operational costs with benefits from improved road maintenance. It is expected that improved monitoring data would allow Member States to better control contracting works for maintenance, leading to cost savings in the longer run. As indicated in the problem definition, preventive maintenace helps to reduce long-run costs (see also Annex 8: Road asset condition). **Both measures** could contribute to helping Member States more effectively identify and address maintenance gaps, and hence it can be expected that they will reduce maintenance costs in the longer term, thereby offsetting any additional administrative costs.

12.2.4. Macroeconomic environment

As indicated in section 2.1.2, improvements in road quality have positive impacts on the wider economy. First order effects include direct employment in construction and materials supplying industries, while second order effects occur in the production sector in response to the demand for additional inputs required by construction materials supplying industries. According to the studies referred to earlier, the value of these first and second round of effects for investments in transport infrastructure have a total multiplier effect of around €2.4 (range from €2.2 to 2.8) for each €1 invested.

12.2.5. Competitiveness of EU economy

Investments in improving the quality of roads are likely to have an overall positive impact on economic performance due to increased connectivity, accessibility and connections for international trade (European Commission, 2011). Connectivity is a key criterion in decisions related to the localisation of a new business or factory. Better road quality is associated with competitiveness improvements due to the lower operational costs for road users and better connections, which will improve the efficiency of transport and contribute to a more competitive economy.

12.3. Main environmental impacts

The impacts on climate change, air pollution and noise (issues identified in the problem definition, section 2) would be positive in the case of both policy measures to the extent to which they can influence increased investment in road maintenance and thus improve the quality of roads. The impact assessment support study (Annex C) has further details on the related literature.

12.4. Main social impacts

12.4.1. Safety (risk of accidents)

Similarly to the case of environmental impacts, as described in the problem definition and noted under the analysis of congestion, poor road condition can increase accident rates. To the extent that the policy measures encourage better planning of road maintenance and higher road quality, they could be expected to decrease the risk of accidents.

12.4.2. Equal treatment of EU citizens

Measure A would have a positive effect on equal treatment because it aims to ensure that there is transparency both with the setting of toll levels and the use of revenues. The former could improve the acceptance of some charges and would help to protect user rights by enabling them to scrutinise the rationale. Clearly stating the components of such charges could facilitate a wider debate about what such charges should or should not cover and enable user groups, or others, to apply political pressure where this was appropriate to change the way in which charges are estimated.

Measure B would also benefit equal treatment of EU citizens, by ensuring that approaches to monitoring road quality are similarly implemented across Europe, and helping to harmonise the divergent practices seen today.

12.5. Comparison of options to improve road quality

12.5.1. Effectiveness

With regard to the goal of ensuring adequate road quality, the main policy packages, including measures to increase the uptake of road tolls, which can generate additional revenues, would be more effective if combined with specific measures targeting road quality. Since monitoring road quality and reporting on toll revenues and expenditures are not mutually exclusive but are rather complementary, the most effective option is to use these measures in concert.

12.5.2. Efficiency (cost-effectiveness)

In the case of **Measure A**, the requirements call for reporting of information that is already collected by Member States. Hence the additional costs are low. At the same time, the obligations to act on the available information are also limited. This option can therefore be seen as creating enabling conditions that can smooth the way for better road quality through providing more information/transparency, without any guarantee of this outcome.

Conversely, **Measure B** would require greater changes for at least some Member States in the form of changes to monitoring practices and/or equipment. This is more administratively intensive and will likely involve some amount of additional cost for implementation, especially if expensive equipment is needed. The cost can be mitigated through use of innovative measurement approaches. The introduction of best practice indicators under Measure B may also help to improve contracting of maintenance works. Measure B can help to identify problems of road quality as part of an overall asset management system, whereas Measure A can help to improve information flows that could identify maintenance expenditure gaps. Both measures could therefore contribute to cost savings due to preventative maintenance.

12.5.3. Coherence

The findings of the impact assessment support study suggest that if Measure A was introduced, it would be useful to further support the ongoing actions being taken at the

international level by the OECD/ITF to increase standardisation of definitions, thereby ensuring coherence with existing initiatives.

12.6. Overall conclusion / preferred option

On the basis of the analysis, it is clear that combining measures A and B is preferred, and it is recommended to introduce them in concert with the preferred main policy package.

13. ANNEX 13: IMPACT OF CONGESTION CHARGING ON LOCAL COMPETITIVENESS[91]

13.1. Approach

Congestion charging can have broad economic impacts on the profile and competitiveness of the region in which it takes place. Transport infrastructure plays a key role in the location of economic activity and individuals, in the efficient operation of the economy and in shaping the fabric of cities and towns. Altering the cost of using one part of the system can have knock-on effects on the geographical distribution of economic activities and their competitiveness by changing the area's comparative advantage as a place to live, do business and visit. There are opposite effects at play: on the one hand the charge can make an area more costly and less attractive to some businesses; on the other, the improved traffic conditions boost its competitiveness. These drivers are likely to affect different businesses differently and could result in shifts in the mix of economic activities in some areas.

An extensive search of the literature has not provided information on the economic effects of local charges. At the same, time dealing with this issue using the same modelling tools used for the analysis of the packages of options would be extremely complex, full of arbitrary assumptions and would therefore not yield any meaningful results. Thus, a simplified approach has been developed to analyse the regional impacts of congestion charges.

The approach presented here is based on the relationship between accessibility and local/regional impacts. This relationship is explored in the literature, although in theoretical terms rather than providing empirical quantifications (also because disentangling the effect of accessibility to other local drivers is complex). However, at least one model exists which use accessibility changes to derive regional economic impact (Spiekermann and Wegener, 2006).

A congestion charge increases travel cost on some roads -> given the higher cost, some traffic is diverted to other roads or modes -> given the lower traffic speed is improved on charged roads -> the generalised cost to travel is therefore modified because of higher cost but lower travel time -> a different generalised cost means a different accessibility -> a different accessibility has an impact on the regional economy.

In order to capture the range of possible impacts of congestion charging on regional economies, several types of regions need to be considered:

a) Regions that are considered to be "attractive" (i.e. in this case productive) areas.
b) Regions that experience various levels of congestion.
c) The effect of a congestion charge on demand depends on many local factors. For instance, the impact of the charge on traffic is heavily dependent on the overall level of congestion on the network, the available alternatives to charged corridors and so on. It is however impossible to consider local conditions at the required level of detail for the analysis. Instead, some parameters can be used to reflect the elasticity of demand and test what happens if different levels of elasticity are assumed.

[91] Source: Ricardo et al. (2017), Support Study for the Impact Assessment Accompanying the Revision of Directive 1999/62/EC.

Therefore, the approach uses an estimation based on parametric assumptions for some sample regions. Given the importance of local conditions in determining the results, the quantitative outcome of the approach is provided as range of values for the potential effect. It is also accompanied by notes to highlight the elements that should be considered on a case by case basis to assess whether the impact would be likely to fall closer to the lower or the higher threshold.

13.2. Methodology

The methodology to model regional economic impacts involved the following steps:

a) For each region a potential accessibility indicator is calculated with reference to the NUTS3 regions within a distance of 300 km. It is assumed that beyond this threshold the effect on local economy is negligible. A potential accessibility indicator is calculated as:

$PAi = \Sigma_j (GDP_j * \exp(-0.075* \text{Generalised Cost}_{ij}))$

Generalised cost is defined as the monetary cost plus the monetary equivalent of travel time[92].

b) A congestion charge is assumed to be applied on paths connecting Origin-Destination pairs where, according to the modelled speed, some congestion occurs[93]. The application of the charge has two effects. First, it increases the travel cost on the O/D pair. Second, it improve speed on the O/D pair by reducing some of the traffic flow. Both these two effects depend on local conditions (see section 3 below). This defines range that encompasses the potential for a low and a high impact.

c) By considering combinations of the low and high impact on travel cost and the low and high impact on travel speed, four scenarios are defined (low effect on cost and low effect on speed, high effect on cost and low effect on speed, etc.). For each scenario the accessibility indicator is recalculated.

d) From the data reported in Spiekermann and Wegener (2006), the elasticity of regional GDP to a change of accessibility is estimated to be 0.25 (i.e. a percentage point improvement of the accessibility[94] gives rise to a 0.25% increment of regional GDP).

e) The elasticity is applied to the accessibility change in each scenario with respect to the reference case. Four different values are obtained from which minimum and maximum effect can be identified.

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[92] A value of travel time of 15 Euros/hour has been used to compute the generalized travel cost. Value of travel time depends on local conditions. Representative values for road transport in European countries (Victoria Transport Policy Institute, 2010) range from 4 Euros/hour for non-working trips to 6 Euros/hour for commuting trips, 21 Euros/hour for business trips to 45 Euros/hour for trucks. The chosen value of 15 Euros/hour is representative of all types of traffic (passenger and freight) taking into account that congestion charge should be applied in peak time where commuting trips are a large share of car trips.

[93] Speeds are drawn from the TRUST model. It should be noted that the approach is based on the identification of origin-destination pairs where speed is below ideal free-flow speed. It is unimportant to detect exactly on which links congestion occurs.

[94] In the study used to estimate the elasticity, the accessibility indicator is a potential one, so the methodology is consistent. Furthermore, data related to the impact of a road charging scenario has been considered.

As discussed above, the approach is a parametric one, adopting a low and high threshold for the assumed impact of congestion charging on travel cost and travel speed. In order to understand if in a specific region one should expect lower or higher elasticities, there are several elements to be considered as discussed in Figure 13-1.

Figure 13-1: Main factors affecting elasticity of travel demand

Impact of congestion charge on travel cost	Impact of congestion charge on travel time
The size of the charge. The larger the charge applied, the greater the increase in travel cost.	**Availability of alternative routes**. When some links are charged, spill over effect on other links can occur. This is more likely when different options are available. If alternative routes are lacking either because the infrastructures are poor or because the whole network is congested (as it often is the case around metropolitan areas), the elasticity of demand will be lower. It should be also considered that if one road is congested and other roads on the same corridor are not, most likely the level of service (i.e. speed) on the alternative routes is anyway lower than on the most used link (otherwise as soon as congestion arises some vehicles would switch on alternative road). Therefore even when alternatives exist and some traffic is diverted onto them, the overall effect on average speed of trips is hardly large.
The length of the charged network. The relevant travel cost is for origin-destination pairs. If a congestion charge is applied to some links, the travel cost will be affected more when these links represent a larger portion of the overall trip distance. Even large charges will not affect the total cost very much if they are only applied on a small number of short road stretches.	**The localisation of the charged links**. The availability of alternatives can depend on the position of congested links. Often congested links are close to large attractors (e.g. a metropolitan area, an industrial zone) where many trip are destined to. In this situation it is hard to find alternative routes. In some cases interurban corridors become congested because traffic related to several different O/D pairs sharing part of their route converge to the same infrastructure. This second case is generally more favourable to find alternatives.
The initial travel cost. The same charge level can have a different impact depending on the initial cost. Especially making reference to perceived costs, a given charge will raise car travel cost more than truck travel cost.	**Availability of alternative modes.** Another reaction to road charging can be mode shift. This is more likely when good alternative services (e.g. rail connections) exist along the corridor.
	The length of the charged network. As already mentioned for travel cost, if travel time is referred to the whole trip, the effect of a congestion charge depends on the share of route charged. If the policy is applied to only a minor part of the route, even in case demand reacts significantly, the overall effect on the average travel speed for the trip will be small.
	Flexibility of departure time. If a congestion charge is applied only in peak hours, travellers who can move their departure time before or after the charged period can avoid paying the charge (and at the same time traffic in peak time is reduced). The larger the share of demand with a flexible travel time and the larger the effect on travel speed.
	Average income. Demand of higher income groups is usually less elastic than lower income groups'. If the congestion charge is based on an estimation of marginal cost of congestion and, in turn, such an estimation is based on some demand curve, the average level of income will be reflected in the level of the charge (as the demand curve will be more or less steep). However if an average value e.g. by country is applied in region with significantly different levels of income the response of demand can be diverse.

13.3. Model results

The results summarised in Figure 13-2 were obtained, assuming elasticities within a reasonable range as defined above.

Figure 13-2: Impact of congestion charge on regional economies –results

Zone Type	Region	Effect on regional GDP
1	A region located at medium distance from a large economic pole and with a few congestion spots along its connections (e.g. Essex CC (UK))	Min -0.6% Max 0.5%
2	A region located in the middle of a large productive area where congestion is significant especially on short/medium distance (e.g. Milan (IT))	Min -0.7% Max 0.4%
3	A region which is the main economic pole in a large area where congestion is significant (e.g. Warsaw (PL))	Min -0.5% Max 1.0%
4	A region located in an area where GDP is evenly distributed congestion is limited to some spots (e.g. Oporto (PT))	Min -0.3% Max 0.3%
5	A region located at medium/long distance from main economic poles and in an area with widespread congestion (e.g. Harz (DE))	Min -1.1% Max 0.7%
6	A region located at medium/long distance from an economic pole and with some congestion along its connections (e.g. Maine et Loire (FR))	Min -0.3% Max 0.2%

The main findings from the calculations are:

- The effect of congestion charges on regional economies are expected to be limited. This seems reasonable, since congestion charge should be limited in space and time. Furthermore, even if the charge can improve travel speed it will also increase travel cost, so the impact on accessibility is not necessarily positive in all circumstances.
- The effects are larger where the effect on speed is assumed to be bigger and the effect on cost is assumed to be smaller.
- The effect is larger where there is more congestion (even if in more congested areas, demand has probably fewer alternatives and so the more optimistic scenario based on higher elasticity of speed is unlikely).
- The impact is different across regions not only because of different levels of congestion, but also because congestion is "located" at diverse distances from the economic poles. Where charged (i.e. more congested) links are those connections to the main economic poles, the impact on the economy is larger. Again this is not surprising. One message behind this result is that if congestion exists on a corridor because of poor infrastructure (i.e. even if surrounding regions do not generate much traffic, demand is forced to use the only road available) a congestion charge is not effective.

In summary, the main purpose of congestion charging can be the internalisation of congestion cost or to disincentive drivers to use congested roads and improve the level of service. Congestion charges can have indirect effects including those on local economies; however these indirect effects are probably not large and do not represent a major factor that will determine the overall success of the charge.

14. ANNEX 14: SME TEST[95]

14.1. Consultation with SME representatives

Consultation with SMEs took place throughout the following processes:

- The open public consultation (12 weeks from 8th July 2016) gave SMEs the opportunity to respond directly to the questionnaire:
  - Seven SMEs in the road haulage sector (from Spain, Austria, Hungary, Poland and Portugal) responded to the consultation.
  - Representatives of SMEs (UETR and UEAPME) responded to the public consultation via answers to the survey or through submission of a position paper.
- Interviews were carried out with two SMEs, who requested to be remain anonymous. The questions covered potential impacts on SMEs of different policy measures.
- Interviews with all stakeholders included questions that invited interviewees to think specifically about the potential impacts on SMEs and whether they might be disproportionate.

As can be seen above, direct feedback from SMEs via the survey and interviews was limited and so their responses cannot be considered representative. Where we were able to speak directly with two individual SMEs in the interviews, their responses were broadly supportive of the changes in terms of reducing the environmental impact of goods vehicles and congestion, as well as re-investing revenues into road infrastructure. The position of UEAPME was to support the proportional pricing of vignettes and phasing out of vignettes for HGVs (with optional distance-based charging). They did not support the inclusion of freight vehicles in congestion charges given that cars are the primary cause of congestion. Nor did they support the inclusion of CO_2 emissions in the Eurovignette Directive since CO_2 emissions are generally internalised through fuel taxation and thus this type of charging (if applied on top of existing charges) could lead to double taxation.

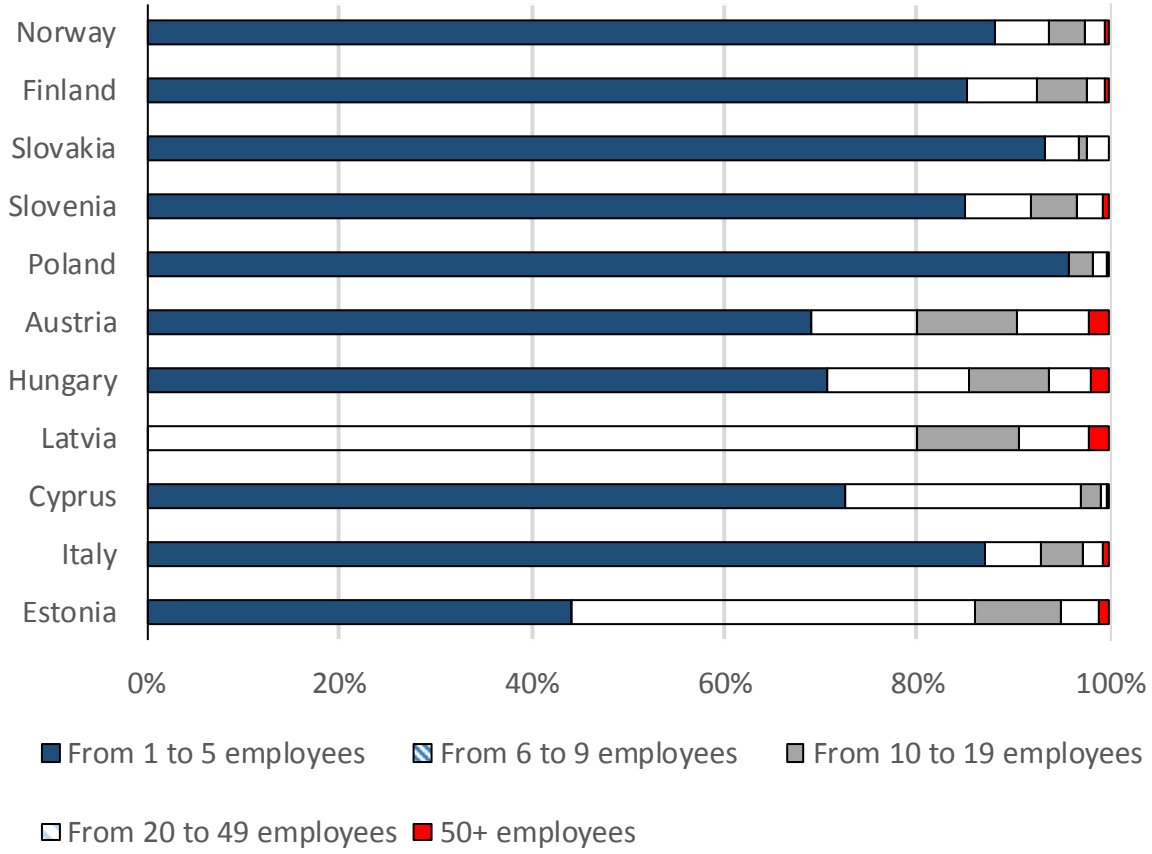
More generally, all interviewed stakeholders were invited to provide their perspective on possible impacts on SMEs; however most did not have an opinion or did not respond to this question. Of the few responses received, one hauliers association (PL) believed that SMEs would find the policy measures more challenging, as these firms had fewer resources to invest in cleaner vehicles, new equipment or pay higher road charges. An interviewee from an EU-15 national authority highlighted the costs of investing in new equipment - such as on-board systems- would have a disproportionate impact on SMEs, particularly for occasional road users. Conversely, another EU-15 National ministry (who requested to remain anonymous) responded that they did not foresee any particular costs burdens for SMEs.

[95] Source: Ricardo et al. (2017), Support Study for the Impact Assessment Accompanying the Revision of Directive 1999/62/EC.

14.2. Assessment of businesses likely to be affected

SMEs play a significant role in the road haulage industry. The market structure is characterised by having a small number of large, pan-European logistic companies providing complex services at the top, which dominate the largest contracts but subcontract a significant proportion of their work to SMEs (AECOM, 2014). This is illustrated in the data from Eurostat on company size (Figure 14-1). For the countries where data is available, SMEs with less than 50 employees represent 97-100% of all road haulier enterprises in 2012 (the latest year for which data are available). The vast majority (80-97%) are micro-SMEs, i.e. companies with fewer than 10 employees. At the EU level, 90% of enterprises in the sector have fewer than 10 employees and account for close to 30% of turnover (including self-employed) (Eurostat, 2017).

Figure 14-1; Size of enterprises in the Haulage Industry in 2012



Source: (Eurostat, 2017) - Adapted from road_ec_entemp

The haulage industry is highly competitive and operators are forced to operate on low profit margins (AECOM, 2014). Cost pressures for logistics providers mean that many heavily rely on subcontracting less profitable operations to smaller enterprises and owner-operators (AECOM, 2014). This presents a risk that additional road charges could push some players out of the market, especially among smaller firms that tend to compete mainly on price (WTO, 2010). The risk of such impacts is examined further below.

14.3. Measurements of the impacts on SMEs

The proposed policy measures will likely lead to **increases in the costs of transport**. SMEs may be disproportionately affected by these increases, since a large firm may be better able to absorb increased costs of road pricing compared to a smaller firm (Mahendra, 2010). As shown in the modelling results, small increases in the cost of transport are foreseen for all options due to the introduction of new road tolls in certain Member States and the greater use of external cost charges (and to a lesser extent, mark-ups in mountainous regions).

The capacity to offset additional costs from road user charging may differ depending on the size and competitive position of firms. It could be argued that SMEs may have lower capacity to optimise their operations, and hence would be most affected by road charges. Evidence from Germany and Switzerland suggests that road hauliers were able to offset higher road charges through reducing empty runs or increasing loading factors (BMT Transport Solutions, 2006); (CEDR, 2009). SMEs with smaller vehicles and fleets, or a lower density customer network, could lack the scale needed to enhance efficiency according to these mechanisms. A qualitative study of the effect of the UK HGV levy on Irish hauliers also suggested that the costs would be borne by industry, due to their *"low bargaining power to push the road* charge on to freight forwarders and exporters" (Vega & Eversa, 2016). In addition, extending the Directive to HGVs <12 tonnes could potentially have a greater impact on SMEs since, according to one interviewed stakeholder (UK authority), SMEs typically operate smaller vehicles.

That said, it is generally assumed that 100% of cost increases due to road tolls are passed through, consistent with experience in several European countries. For instance, in Germany, Austria and Switzerland, the cost increases after introduction of tolls were passed to customers (BMT Transport Solutions, 2006); (Ruehl et al, 2015). Although these studies did not specify whether the results applied specifically to SMEs, since the haulage industry is made up almost entirely of SMEs it seems reasonable to assume that the outcome of passing through most (if not all) of the additional costs is representative. As such, it is expected that increased transport costs in PO1-4 will not have significant disproportionate impacts on SMEs.

Introducing **congestion charging** will also likely impact SMEs, since they have lower flexibility in their operations (as described above). SMEs with operations based primarily in affected areas (e.g. that often travel through congested road networks), or that have fewer resources available to be flexible in the timing of operations (e.g. from a shift to off-peak operations) would be disproportionally affected by increased charges. In particular, small firms may have no choice but to drive in peak hours because they have to maximise utilisation of their vehicles (Mahendra, 2010).

Interview feedback from a pan-European logistics company was that congestion charging is particularly challenging for trucks, as deliveries are often dependent on the demand of customers. This is demonstrated by the introduction of the congestion charge in London, where the number of goods vehicles remained almost unchanged, indicating that hauliers did not change behaviour in order to avoid the charges (CEDR, 2009). In their position paper, UEAPME noted that transport companies are already motivated to avoid congestion and

driving in peak times would be because they have no alternative choices, and suggested that freight vehicles should be exempted from congestion charges.

At the same time, the same firms would likely benefit from lower congestion, which would result in time savings and an effective increase in the catchment area for the business. If the congestion charge is effective, it will improve the reliability and speed of deliveries along the supply chain. Given the limited real-world experience with inter-urban congestion charging, it is difficult to say what the net impacts would be – however, evaluations of the London congestion charge found no discernible impact on businesses (TfL, 2008), suggesting that more limited, targeted interurban congestion charging foreseen in the policy options would not have significant impacts (positive or negative).

Finally, the proposed measures to **promote zero-emission vehicles (included in PO1-4) through allowing lower road user charges** could have different impacts on SMEs compared to larger firms. In general, the impact on firms from this measure is expected to be positive, since the lower per-km road charges will contribute to lower running costs overall (in addition to other fiscal incentives, such as tax breaks and lower prices for alternative fuels). Over time, these lower running costs should more than outweigh the additional purchase costs of zero-emission light vehicles compared to a diesel equivalent (EEA, 2016b); (Energy Saving Trust, 2017). Taking subsidies into account, the total cost of ownership of a commercially-owned electric van is lower than a conventionally-fuelled van in most Member States – with larger savings if annual mileage is higher (Schimeczek et al, 2015).

SMEs in particular may face more difficulties in making the upfront investment for the more expensive vehicle. For example, Nissan e-NV200 electric van is 47% more expensive to purchase and lease compared to its diesel equivalent, the NV200 (Low Carbon Vehicle Partnership, 2016). For HDVs the differences in purchase costs compared to conventional vehicles is even larger, with retail costs of electric trucks being between 170% and 280% higher than a conventional equivalent (CE Delft, 2013).

If SMEs are less able to purchase or lease zero-emission vehicles, they will initially benefit less from the measure compared to a larger firm – both in terms of have less potential to access the lower rates for road user charges, as well as the co-benefits of owning zero emission vehicles in the form of lower fuel costs etc. There are, however, two reasons that the impact may not be a concern in the longer term:

- Firstly, the difference in investment costs between zero-emission vehicles and conventional vehicles is largely due to the powertrain costs (i.e. the battery). It is widely predicted that the cost of batteries will decrease significantly between 2015 and 2030 (Wolfram & Lutsey, 2016) - meaning that upfront investment will be less of an issue than today.
- Secondly, SMEs typically buy their vehicles on the second-hand market (BCA, 2012). If the measure stimulates additional first-hand purchases of zero-emission vehicles, these will eventually reach the second-hand market and SMEs will benefit from having access to zero-emission vehicles that they would otherwise not have been able to purchase.

14.4. Assess alternative options and mitigating measures

The analysis shows that the initiative might result in a slight disproportionate increase in costs for SMEs, but this is generally found to be small and likely to be passed on to customers. Experience from existing HGV road user charges (a sector primarily made up of SMEs) in countries such as Germany, Switzerland and Austria found that increases in costs were generally small and passed on to customers (Ruehl et al, 2015). Impacts from interurban congestion charging are expected to be limited. Consequently, there is no indication of a need for SME-specific measures in order to ensure compliance with the proportionality principle.

15. ANNEX 15: THE ROAD INITIATIVES – THE 'BIG PICTURE'

15.1. Introduction

The Road Initiatives, which are all REFIT Initiatives, are fully inscribed in the overall priorities of the Juncker Commission notably under the 'A deeper and fairer Internal Market' and the 'Climate and Energy Union'.

The Communications from the Commission on 'Upgrading the Single Market: more opportunities for people and business' and on 'A Framework Strategy for a Resilient Energy Union with a Forward-Looking Climate Change Policy' explicitly refer to the Road Initiatives.

The table below presents the link between the Juncker priorities, the Impact Assessments prepared for the Road Initiatives and the related legislative acts.

Priorities	IAs	Legislation
A deeper and fairer Internal Market	Hired vehicles	Directive 2006/1
	Access to the haulage market and to the Profession	Regulation 1071/2009 & 1072/2009
	Social aspects: Driving/rest time, working time and enforcement measures (tachograph), Posting of workers and enforcement measures	Regulation 561/2006 and Regulation 165/2014
		Directive 96/71, Directive 2014/67, Directive 2002/15 and Directive 2006/22
	Access to the market of buses and coaches	Regulation 1073/2009
Climate and Energy Union	Eurovignette	Directive 1999/62
	European Electronic Toll Service (EETS)	Directive 2004/52
		Commission decision 2009/750

Moreover, the transport strategy of the Commission as laid down in the White Paper "Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system" adopted on 28 March 2011, included references to the road initiatives[96].

15.2. The EU road transport market

Road transport is the most prominent mode of transport. In 2014, almost three quarters (72%) of all inland freight transport activities in the EU were by road. On the passenger side, the relative importance of road as mode of transport is even greater: on land, road accounts for more than 90% of all passenger-kilometres: 83% for passenger cars and almost 9% for buses and coaches.

Almost half of the 10.6 million people employed in the transport and storage sector in the EU are active in carrying goods or passengers by road. Road freight transport services for hire and reward employs around 3 million people, while the road passenger transport sector (buses, coaches and taxis) adds another 2 million employed persons (a third of which are taxi drivers). This corresponds to more than 2.2% of total employment in the economy and does

[96] More specifically in the Annex under points 6, 11 and 39

not include own account transport which in road freight transport alone provides employment for 500,000 to 1 million additional people.

There are about 600,000 companies in the EU whose main business is the provision of road freight transport services for hire and reward. Every year, they generate a total turnover of roughly €300 billion, around a third of which is value added by the sector (the rest being spent on goods and services from other sectors of the economy). The provision of road freight transport services for hire and reward is hence an important economic sector in its own right, generating almost 1% of GDP.

In road passenger transport, there are about 50,000 (mostly) bus and coach operators (of which 12,000 provide urban and suburban services, (some including tram and underground)) and around 290,000 taxi companies in the EU. Together, they generate a turnover of €110 billion. Without taxis, total turnover of the sector is around €90 billion per year, of which some €50 billion is value added.

15.3. Why is there a need for action?

Road transport is for a large part international (around 34%[97]) and this share is increasing, which explains the need for a common EU legal framework to ensure efficient, fair and sustainable road transport. The framework covers the following aspects:

- Internal market rules governing access for operators to the markets of freight and passengers
- Social rules on driving/rest time and working time to ensure road safety and respect of working conditions and fair competition
- Rules implementing the user and polluter pays principles in the context of road charging
- Digital technologies to enable interoperable tolling services in the EU and to enforcement EU rules (e.g. the tachograph)

It is clear that current rules are no longer fit for purpose. Member States are increasingly adopting own national rules to fight "social dumping" while acknowledging that their actions have adverse effects on the internal market. Moreover, public consultations have shown a strong support for EU action to solve current issues in road transport. For example:

- Severe competition in the road transport sector has led many operators to establish in low-wage countries without necessarily having any business activity in these countries. There is a lack a clear criteria and enforcement mechanisms to ensure that such establishment practises are genuine, and that there is a level playing for operators.
- Measures on Posting of Workers implemented in 4 Member States (DE, FR, AT and IT) are all different and obviously from other Member States which have not implemented any measure to implement the minimum wage to road transport on their territory. Stakeholders ask for a common set of (simplified) enforcement rules.

[97] Statistical Pocketbook 2016, EU Transport in figures

- CO2 emissions from road transport represent a large share of total emission and the share is set to rise in the absence of common action (at EU 28 level), which is needed to contribute substantially to the commitment under the Paris Agreement and to the 2030 goals.

- Due to the increasingly more and more hyper-mobile nature of the sector, there is a need for common and enforceable rules for workers. All workers should benefit from the same level of protection in all Member States to avoid social dumping and unfair competition between hauliers. This is currently not the case.

15.4. What are the main problems?

The Internal market for road transport is not complete. It is our assessment that the current situation does not allow to exploit the full potential of transport services

- e.g. current rules on bus/coach services or the rules on hired vehicles are still very restrictive. Some Member States have decided to unilaterally open their market, which has led to a fragmentation of the EU internal market.

Many rules are unclear, therefore leading to different level of implementation by Member States and problems of enforcement:

- e.g. on cabotage where all stakeholders agree that current rules are unenforceable

There are allegations of 'social dumping' and unfair competition in the road transport sector. This has led to a division between East and West in Europe. As a consequence, several Member States have decided to take national measures, which might jeopardize the unity of the EU market for road transport:

- E.g. minimum wage rules in DE, FR, IT and AT coupled with disproportionate administrative requirements ; prohibition of drivers taking the weekly rest in the cabin of vehicles in FR and BE

Environmentally, we have made good progress on reducing pollutants from Heavy Good Vehicles but our legal framework currently does not address the issue of climate change (CO_2). At the same time, the infrastructure quality is degrading in the EU despite that fact that user charges and tolls are levied on most TEN-T and motorways.

Electronic tolling systems in the EU are, despite the primary objective of the EU legislation of "one contract/one on-board unit/one invoice" for the users, far being interoperable. More generally, the benefits of digitalisation are still under-exploited in road transport, in particular to improve control of EU legislation (e.g. many Member States do not currently the use of electronic waybills).

15.5. Options and main impacts

To achieve these objectives, all IAs will consider a range of different options, which ultimately should improve the efficiency, fairness and sustainability of road transport.

The IA on Hired Vehicles will assess options aiming at removing outdated restrictions on the use of hired goods vehicles and thus at opening up new possibilities for operators and leasing/hiring companies alike. More flexibility for the hiring of vehicles should lead to more efficient operations, higher productivity and less negative environmental impacts as fleet renewal will be promoted.

The IA on Access to the haulage market and to the Profession will study various options to ensure effective and consistent monitoring and enforcement of the existing rules in Member States and to ensure coherent interpretation and application of the rules. Three broad groups of potential measures will be assessed, namely measures liable to improve enforcement, measures ensuring simplification and clarification of current rules and measures reinforcing the cooperation between Member States.

The IA on Access to the market of buses and coaches will assess options aiming at improving the performance of coach and bus services vis-a-vis other transport modes, especially private car and further developing the internal market for coach and bus services. This should lead to a reduction of the adverse environmental and climate effects connected with mobility. Various policy options will be considered for creating more uniform business conditions and also a level playing field for access to terminals.

The IA on Social aspects of road transport will study options aiming at ensuring the effectiveness of the original system put in place and therefore contributing to the original policy objectives, i.e.: (1) to ensure a level playing field for drivers and operators, (2) to improve and harmonise working conditions and (3) to improve the road safety level. An additional objective, in the context of the implementation and enforcement of the provisions on posting of workers, is to ensure the right balance between the freedom to provide cross-border transport services and the protection of the rights of highly mobile road transport workers. In this perspective, three broad groups of measures will be analysed: 1. Simplification, update and clarification of existing rules, 2. More efficient enforcement and cooperation between Member States and 3. Improved working conditions of drivers and fair competition between operators.

The IA on the Eurovignette will assess options to promote financially and environmentally sustainable and socially equitable (road) transport through wider application of the 'user pays' and 'polluter pays' principles. A number of different measures and their variants aiming at correcting price signals in freight and passenger transport will be considered in order to address the issues identified. The policy options range from minimum adjustments to the Directive required for improving its coherence and addressing all policy objectives, through the promotion of low carbon (fuel efficient) vehicles and the phasing out of time-based charging schemes (vignettes) for trucks to the optimisation of tolls for all vehicles.

The IA on EETS (European Electronic Tolling Service) will study options aiming at reducing the cost and the burden linked to the collection of the electronic tolls in the EU – for the users and for the society at large. It will equally seek to improve the framework conditions for the faster and more widely provision of an interoperable European Electronic Toll Service. Different policy options will be considered, including a non-legislative approach (facilitating exchange of best practice, co-financing EETS-related projects) and a legislative review.

These policy options and their impacts will be presented and assessed in detail in the respective IAs.

15.6. Expected synergies of the package

The different initiatives constitute a coherent set of measures which will jointly contribute to an efficient, environmentally and socially sustainable road transport sector. It is expected that the impacts will be more than the addition of the impacts of each initiative, meaning that the initiatives are complementary. Some examples of such synergies are provided below.

- Current restrictions on cabotage are unclear and therefore lead to illegal cabotage. These illegal activities are closely linked with the fact that transport operators established in low-wage countries exert unfair competition via 'social dumping' and not respecting the rights of workers, who often are staying in their trucks abroad for longer periods. This illustrates the clear link connection between compliance of internal market rules and social/fair competition aspects of road transport, which are all addressed by the road initiatives and which cannot be dealt with separately.

- When assessing the laws applying a national minimum wage to road transport, Member States explained the Commission that one of the reasons for adopting these national measures is to fight the phenomenon of fake establishments and “letter box” companies in low-wage countries. Tackling the issue of posting of workers in road transport goes therefore hand in hand with the issue establishment of road hauliers transport operators, which again illustrates the link connection between internal market and social aspects of road transport.

- Promoting interoperability of electronic tolls systems will lead to lowering the implementation costs of such systems by Member States. We can expect that this will incentivise Member States to put in place distance-based tolls, which better reflect the user and polluter pays principles use of infrastructure. This shows the close link between the Eurovignette and EETS initiatives.

- Seeking to improve the performance of coach and bus services vis-a-vis other transport modes will inevitably lead discussion on a level playing between road and rail services. Current EU legislation provides that rail users shall pay for the use of infrastructure, while it is not currently the case for buses and coaches which are outside the scope of the Eurovignette directive. The inclusion of buses and coaches in the Eurovignette initiative to ensure that they pay a fair price for using the road infrastructure is therefore essential and will ensure endure overall coherence.

- The initiatives on hired vehicles is in particular related to the initiatives on the access to the market and to the profession, all having the aim of establishing clear and common rules for a well-functioning and efficient Internal Market for road haulage: some of them by ensuring a good functioning of the market of transport services, others by ensuring the best use of the fleet of vehicles.

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