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**MANAGING ROAD ASSETS IN THE CONTEXT OF  
SUSTAINABLE DEVELOPMENT AND CLIMATE  
CHANGE ADAPTATION**

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## **ABSTRACT**

The development of motorways in the Portuguese road sector is heavily based on the use of Public Private Partnerships (PPP), in the form of concession contracts. The Road Regulator (InIR) launched in 2008 the National Account for Road Infrastructures (NARI) project, whose main goal is to account in detail for all costs and benefits of the road sector, as well as its sustainability, from different perspectives: users, concessionaires and the society. The project was developed according to the guidelines given by different previous projects endorsed by the European Commission.

This paper presents the main conclusions of the NARI for 2008 (its reference year), starting with the presentation of the Portuguese road model and the framework provided by Directive 1999/62/EC (commonly known as the “Eurovignette”), and including the presentation of results concerning the sustainability of the sector, in financial terms (results of the concessionaires), and in social terms (social benefits versus social costs).

A key issue analyzed is the effect of the “Eurovignette” provisions on the calculation of road tolls within the Portuguese system. Given the expected terms of the transposition of Directive 1999/62/EC into national legislation, only concession contracts signed after June 2008 will be affected. The paper presents the comparison between current heavy goods vehicles (HGV) tolls and HGV tolls calculated according to the “Eurovignette”.

## **1. ROAD INFRASTRUCTURE PRICING IN PORTUGAL AND THE EU**

### **1.1. The Portuguese Road Infrastructure Model**

The development of the Portuguese road model during the last decades has been based on the use of Public Private Partnerships (PPP from now on), implemented in the form of State concession contracts. The national motorways experienced a strong growth in terms of kilometres operated since the early 80s thanks to the extensive use of road concessions, more precisely from 216 km in 1985 to more than 2.500 in 2010. More precisely, PPPs are perceived in Portugal as an effective way for rapid delivery of road infrastructure and for the improvement of service to end-users.

This intensive use of PPPs was a key factor behind the success of the National Road Plan (PRN2000) from 1998, a very ambitious plan aimed at the complete modernization of Portuguese road network. Concerning motorways, PPPs were the instrument of choice for the construction of new infrastructures. The evolution of the number of total PPP contracts since 1985 is presented in Figure 1 below: the most intense use of road concessions was the period between 1998 and 2004, with ten new PPP contracts signed for a total of more than 1.200 km of new motorways.

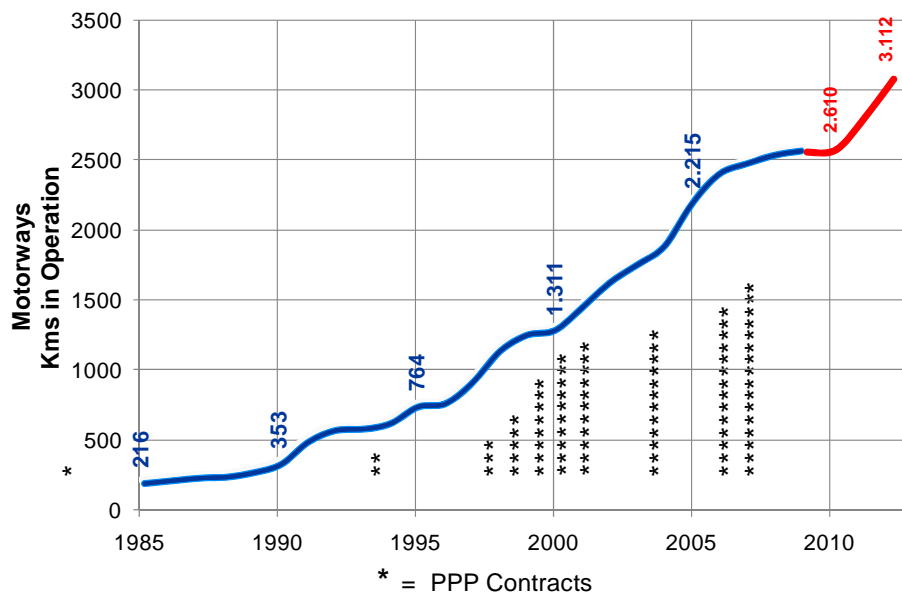


Figure 1 – Evolution of PPP contracts and motorway kilometres in operation in Portugal

The motorway State concession contracts in Portugal have been developed under two different schemes that coexist nowadays:

- Real toll concessions: eight contracts with 1.701 km under operation or construction (the most recent concession contracts were signed under this form);
- Shadow toll concessions: seven contracts with 909 km under operation, being the preferred PPP scheme during the intense motorway development of 1998-2004.

In 2007 the Portuguese Government decided to create a public road concessionaire, *Estradas de Portugal, S.A.* (EP from now on), to which all types of national roads (except those under the control of the municipalities) were concessioned for a period of seventy five years. The objective was to launch new PPPs through the newly created firm, promoting the joint participation of public and private funding in the construction and operation of new motorways. More precisely, new infrastructure would be developed in the form of sub-concessions by the EP.

Under this new framework, the Portuguese Government created a new sector Regulator in 2007, the Institute for Road Infrastructure (InIR from now on), whose main responsibilities are to promote the development of the PRN2000 through planning activities, monitor the evolution of the concession contracts (with both public and private parties) and guarantee the fulfilment of any obligations, monitor the quality standards and contractual service levels of the road infrastructure and serve as the main interface between road users and road concessions. The following figure presents a diagram of the current institutional arrangement of the Portuguese road sector.

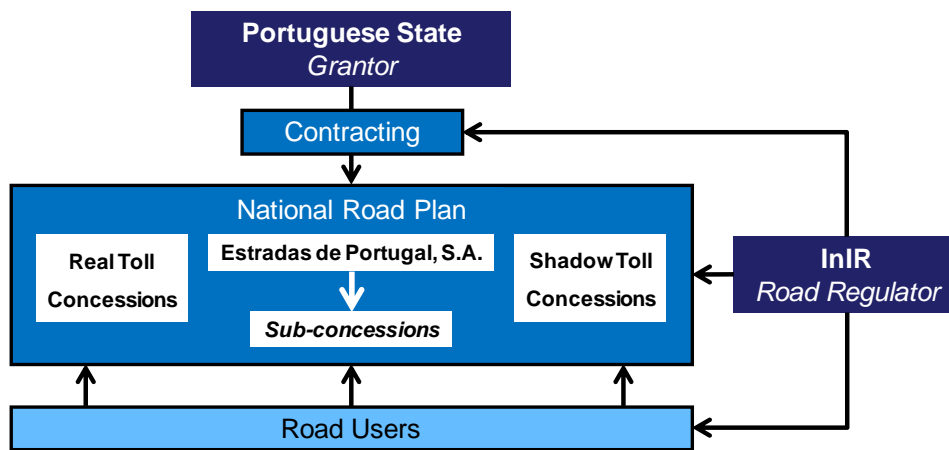


Figure 2 – Institutional arrangement of the Portuguese road sector

Shortly after the implementation of the new development model, the Portuguese road sector was affected by the financial and economic crisis that largely hampered the availability of funding and increased significantly its cost. In order to adapt to this new scenario, the Government and the road Regulator are currently undertaking the task of reassessing the priorities for development of the PRN2000 and the associated sub-concession program.

## 1.2. Road Infrastructure Pricing Policy in the EU and Effects in Portugal

Since the late 90s, the EU has been trying to develop common rules for the application of tolls and user charges in the European roads, as a part of a wider infrastructure policy principle concerning the application of fair prices for the use of different infrastructures and the integration of all costs generated by each transport mode. For this purpose, Directive 1999/62/EC, as later modified by Directive 2006/38/EC, sets the principles for distance-related tolls and time-based user charges for goods vehicles (above 3.5 tonnes) for the use of certain infrastructures, including those belonging to the Trans-European Road Network.

More precisely, Directive 1999/62/EC has two objectives: first, to improve the functioning of the internal market through the approximation of the conditions of competition in the transport sector by reducing the differences in the levels and in the tolling systems and user charges applicable in Member States. And second, to take better account of the principles of fair and efficient pricing in transport by providing for greater differentiation of tolls and charges in line with costs associated with the road use.

Directive 1999/62/EC sets the rules to be followed by Member States in the application of tolls and/or user charges. In summary, the most important of these framework conditions are:

- Tolls and user charges can only be imposed on users of motorways or multi-lane roads similar to motorways, bridges, tunnels and mountain passes;
- Tolls shall be levied according to the distance travelled and the type of vehicle, whereas user charges are scaled according to the duration of the use made of the infrastructure and to vehicles emission classes;
- The directive does not permit the imposition of a toll and a user charge at the same time. However, tolls can be levied on networks where user charges are already imposed for the use of bridges, tunnels and mountain passes;

- National tolls and charges should not be discriminatory and should be set out in such a way to cause as little hindrance as possible to the free flow of traffic as well as to avoid mandatory checks at the EU's internal borders;
- A specific provision of the directive allows Member States to co-operate for the purpose of introducing a common system of user charges. For instance, Belgium, Denmark, Luxembourg, the Netherlands and Sweden have a common system of user charges for heavy goods vehicles above 12 tonnes called the "Eurovignette" system. According to this system the payment of a specified amount confers on hauliers the right to use motorways of the participating Member States for a given period;
- The Directive fixes a maximum level for user charges in accordance with the given period and with the environmental performance of the vehicles;
- The Directive fixes as well the maximum weighted average tolls by requiring that tolls are set in relation to the costs of constructing, operating and developing the infrastructure concerned. Member States may vary the toll rates according to vehicle emission classes and the time of the day and in certain sensitive areas, under certain conditions, tolls may be increased to reflect the environmental sensitivity of the area and provide a further fiscal incentive to reduce traffic.

The EU Member States are currently undertaking the actualization of Directive 1999/62/EC, which would include provisions for the application of tolls and user charges in a wider range of roads and vehicles, as well as the integration of external costs (such as congestion, air and noise pollution costs).

In summary, the dispositions of Directive 1999/62/EC, the modifications by Directive 2006/38/EC and any potential future developments in the matter are aimed at the implementation of a more sustainable road infrastructure sector. In the future, and following a gradual process, the internalisation of all external costs will be the basic principle affecting planning, funding, constructing and managing of roads.

Directive 1999/62/EC and the modifications introduced by Directive 2006/38/EC are currently being transposed into Portuguese legislation. New concession contracts will include the "Eurovignette" provisions for the calculation of tolls, which are very different from the current method applied in real toll concession contracts. Given this new framework, the INR has launched a project that, amongst other, has the specific objective of comparing the present real toll levels in Portugal with those that would result from the application of the "Eurovignette" dispositions.

## **2. THE NATIONAL ACCOUNT FOR ROAD INFRASTRUCTURES**

### **2.1. Project Objectives and Rationale**

The National Account for Road Infrastructures (NARI) project was launched in early 2009 by the Portuguese road regulator. The main strategic goal of the project was to create an accounting tool to support the identification of all costs and revenues stemming from the road infrastructure sector, as well as the associated cash flows, in order to support several areas of the regulator's activities. The main NARI operational objectives can be summarized as follows:

- Enhance the Regulator's capacity to monitor economic and financial performance of road concessionaires, within the framework of a system developed under PPP contracts;
- Appraise de actual cost of road use, road operation and maintenance, supporting the assessment of the service and quality levels contractually agreed;
- Establish a clear link between the cost structure associated with the implementation, operation and eventual expansion of the infrastructure, the price charged to users and the respective service levels;
- Provide a tool to support the implementation of the Eurovignette Directive.

For these purposes, cash flows (real monetary flows) and "economic" flows (economic values of externalities generated by the road sector) between stakeholders were analyzed in order to provide the Regulator with a two-fold insight of the road infrastructure sector:

- From a microeconomic perspective, a view on the financial performance of the road concessionaires, both individually and as a group. This perspective is related to the first and second operational objectives of the NARI, and allows the Regulator, in the medium to long term, to assess the financial sustainability of the road concessionaires, its funding needs and potential for future development;
- From a macroeconomic perspective, a view on the economic performance of the sector as a whole, including the accounting of all costs, benefits and external effects generated by the sector. This perspective is related to the third and fourth operational objectives, and allows the Regulator to assess the socioeconomic sustainability of the road sector and the development of transport planning policies.

A key element related to the activities of the InIR as economic regulator of the road infrastructure sector is the support capability provided by the NARI in terms of design and calculation of road charges. This task combines the micro and macroeconomic perspectives of the NARI, as a road charging system must guarantee, on the one hand, the financial sustainability of the road concessions. And on the other, it must ensure the compliance with the current and future EU guidelines concerning the internalisation of the external costs generated by each transport mode in its charging schemes.

The NARI rationale is based on several EU funded studies, developed according to the previously mentioned guidelines concerning the accounting of all transport costs and revenues (financial and social) and the internalization of external costs and the subsequent development of adequate charging schemes.

More precisely, the project UNITE (*Unification of Accounts and Marginal Costs for Transport Efficiency*) first developed the concept of "national transport accounts", and provides the backbone for the rationale under the NARI structure and concepts. UNITE was developed in 2000-2002 within the European Union's Fifth RTD Framework Programme (1998-2002), being its main objective to supply policymakers with the framework and state-of-the-art cost estimates to develop fair and efficient pricing of transport infrastructure that takes full account of the social costs and benefits of transport. The first step of the UNITE project was to develop the national transport accounts for each mode, in order to compare social costs and charges/taxes on a national level, monitoring the development of total and average costs, revenues, the correspondent structures and

the financial balance. The UNITE accounts were divided into six sections, called “cost categories”, as follows:

- Transport infrastructure costs;
- Transport service supplier operating costs (not considered when calculating infrastructure accounts solely);
- Transport user costs;
- Accidents costs;
- Environmental costs;
- Taxes, charges and subsidies.

The UNITE provided as well guidelines for the monetary valuation of external effects, including tables with national reference values and recommendations for the use of the most adequate up-to-date methodologies.

Another key contribution to the NARI structure and contents came from the IMPACT project (*Internalisation Measures and Policies for all external Cost of Transport*), developed for the European Commission. This project provides the methodological framework for the best practices regarding the calculation of external transport costs, and is currently regarded as a fundamental reference to be taken into account in this field of work.

Finally, the third major conceptual contribution to the NARI was provided by the HEATCO project (*Developing Harmonized European Approaches for Transport Costing and Project Assessment*). Developed in 2004-2006, its main objective was to provide an European set of standard methodologies for the assessment of transport infrastructure projects, including reference values to be used in the appraisal process.

## 2.2. Project Structure and Resources

The NARI project is organised around four main technical areas, as presented in Figure 3, which are the following:

- Road sector stakeholders accounts: includes financial data from the road concessionaires, technical data (traffic, accidents, road characteristics, etc) from InIR, and figures from the National Accounts (mainly concerning taxes and subsidies). Cross check was undertaken between the different sources, in order to validate the data and avoid errors or double accounting. As for instance between taxes declared by the concessionaires and data from the National Accounts, and between traffic data (from the concessionaires and from InIR);
- Sectorial models, focused on the assessment of several external effects and the subsequent monetisation. Includes models and estimates on travel time savings and congestion costs, vehicle operation costs, accidents costs and environmental costs (noise, emissions and global warming). The bulk of calculation methodologies and reference values used by the sectorial models in order to monetise the different cost categories were provided by UNITE, IMPACT and HEATCO projects;

- Complementary studies supporting the sectorial models through the definition of best practices for the calculation of several issues: value of time, fuel consumption and other vehicle running costing models, noise and emissions models, etc. The complementary studies are supported by very diverse types of methodologies, some provided by the three reference studies (UNITE, IMPACT and HEATCO), and some from more specific projects (for instance, those covering vehicle running costs).
- The NARI application, where all data is gathered and presented by cost and revenue category, with a high disaggregation level, allowing the allocation of financial and socioeconomic values not only per road concessionaire but also by type of road or even by road.

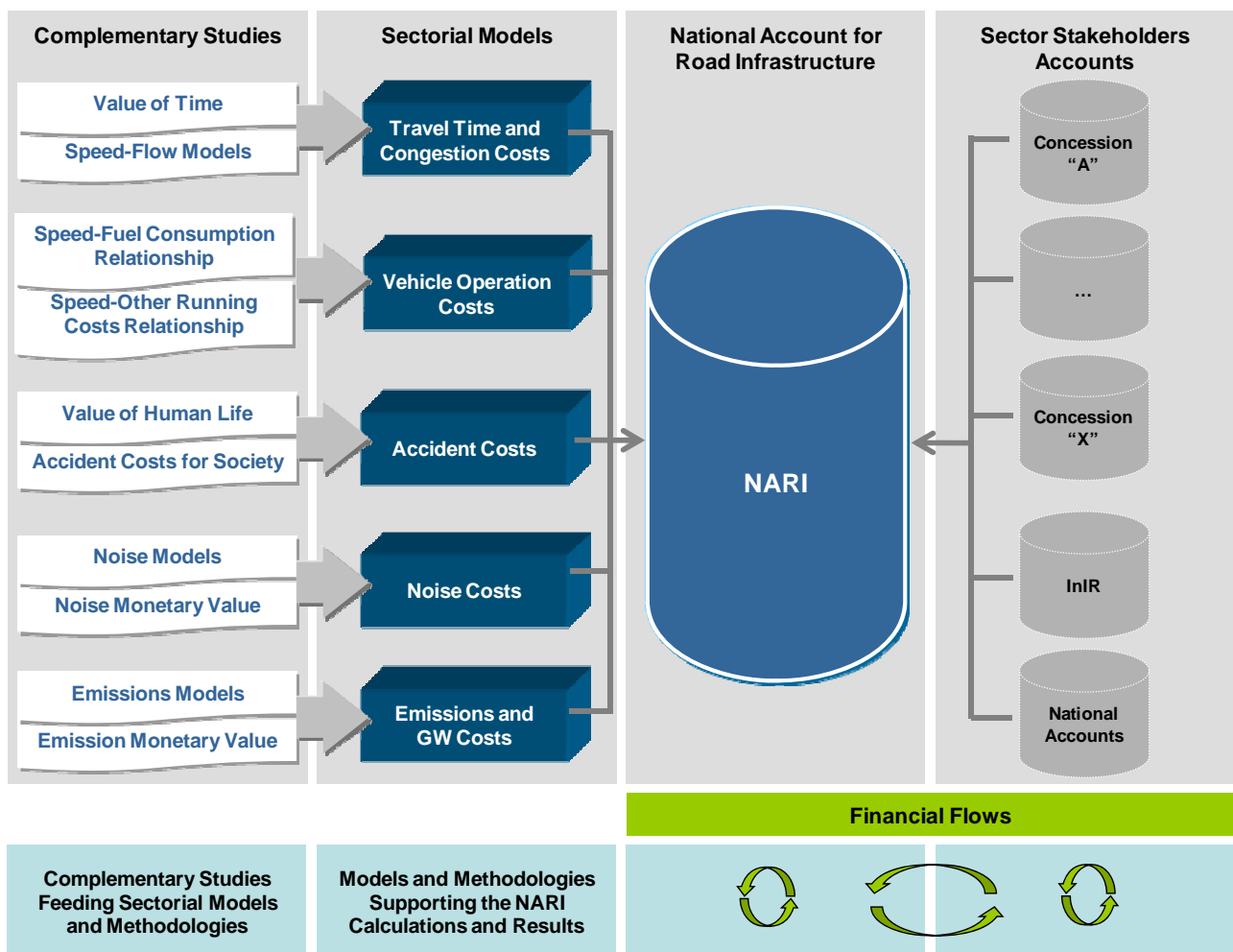


Figure 3 – Overall Structure of the National Account for Road Infrastructures project

The cost categories analysed by the NARI are structured according to the guidelines provided by UNITE, and are the following:

- Road infrastructure costs: includes construction, operation, maintenance, upgrades, depreciation of the capital stock and financial costs;
- Road user costs: tolls paid, fuel and other vehicle operation costs and travel time costs;
- Environmental costs: noise, air pollution and global warming effects;



- Accidents cost.

### 2.3. Main NARI Results

The NARI outputs are organised into four perspectives, according to the type of stakeholder bearing the accounted costs or benefits: road infrastructure users, road infrastructure concessionaires, the society as a whole and the road infrastructure itself. The main results for each of the four perspectives for 2008 (the reference year) are presented in the following paragraphs.

Figure 4 presents the percentage distribution of road network user costs. For 2008, total user costs amounted to 23.8 billion €, being the average cost per kilometre 46,33 €cents. Travel time costs are the largest cost category with 58%, being taxes 20% of total user costs. Amongst taxes, fuel taxes have the highest participation in user costs (8%), followed by VAT (7%). The Road Service Contribution is the only earmarked road tax, and is charged as a part of the fuel retail sale price, being one of the revenues of the public road concessionaire.

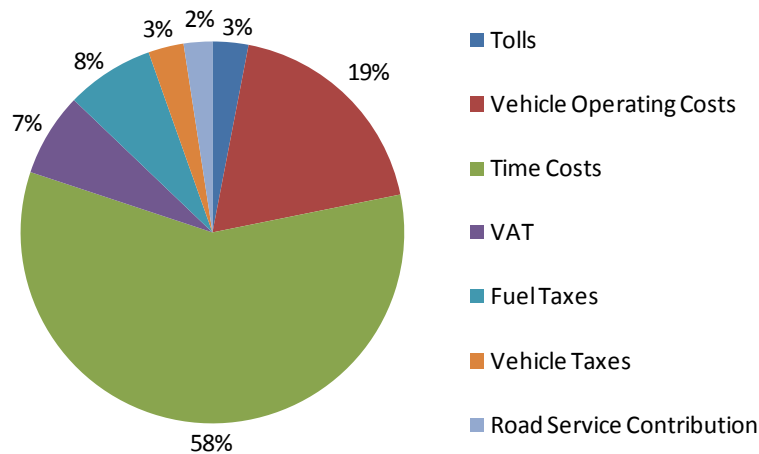


Figure 4 – Road user costs (2008)

The main NARI result concerning the road concessionaires refers to the financial viability of the model. Figure 5 presents the revenue/cost ratios of twelve real toll and shadow toll concessions in operation in 2008, as well as the aggregate ratio for several concessions in the very early stages of construction and/or operation (“Others”, not receiving revenues from tolls), as well as the “network total”. In all, only one concession fully covered its costs with revenues from tolls. Taking into account all revenues, only five concessions reached or surpassed the breakeven. Moreover, from a systemic perspective (network total), the revenues/costs ratio was under 90%, which means that the system presents a substantial annual deficit in financial terms, approximately 400 million € for 2008.

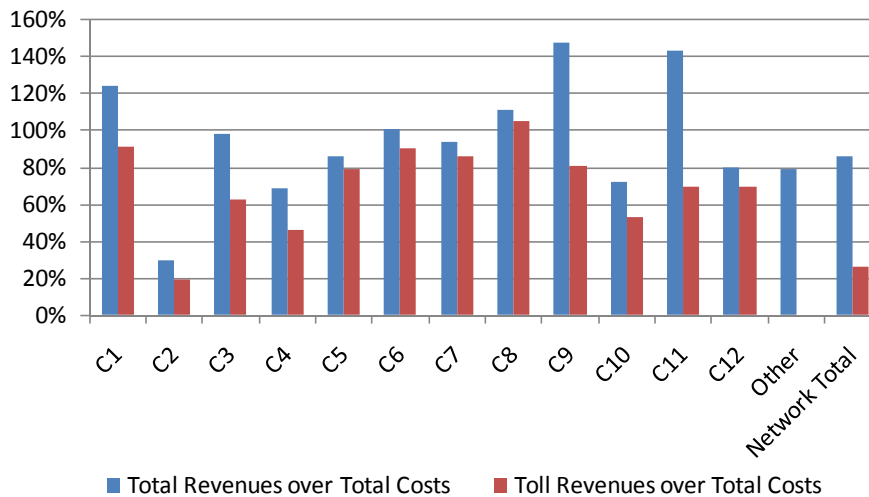


Figure 5 – Road concessionaires revenues/costs ratios in Portugal (2008)

The NARI results concerning the social costs and benefits for 2008 present total costs of 3.1 billion €, and total benefits of 4.9 billion €, with a positive net result of 1.8 billion € (see Figure 6 below). The benefits considered are all the monetary flows from the different taxes related to the sector (fuel, vehicle taxes, etc), being the costs a mix of monetary values (subsidies and transfers to concessionaires) and monetised external effects (accidents, environmental and congestion costs). This result shows that the road infrastructure sector is socially sustainable, even taking into account the internalisation of the external costs generated.

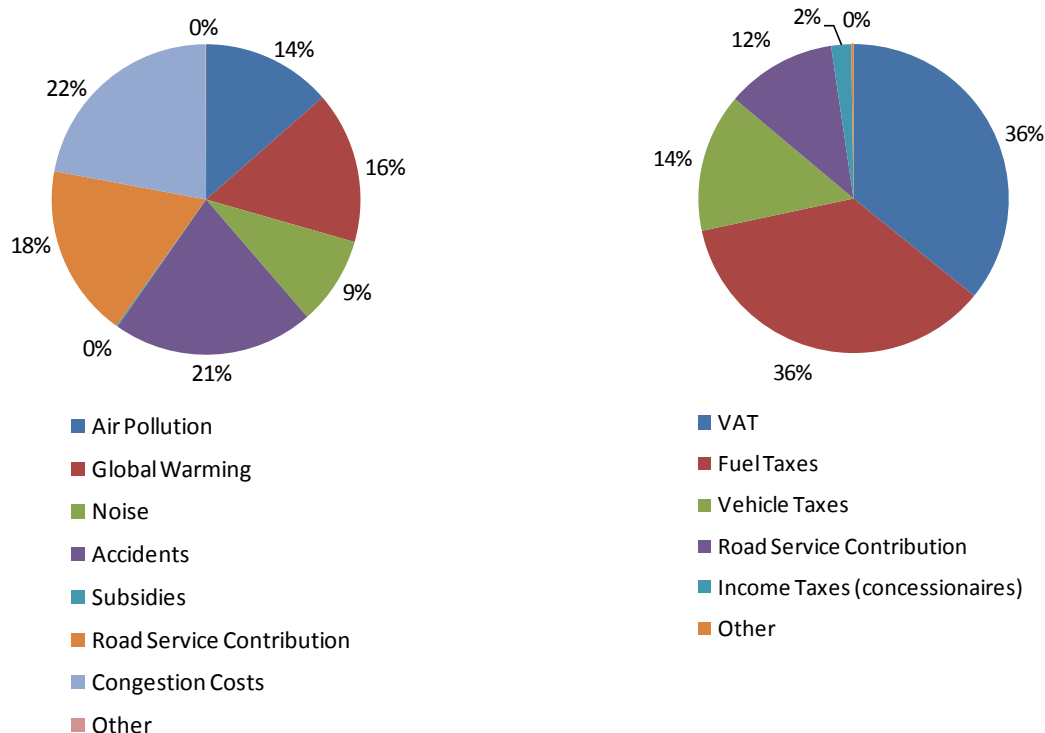


Figure 6 – Social costs (left) and benefits (right) of the Portuguese road network (2008)

### 3. SUSTAINABLE ROAD PRICING: RESULTS FROM THE NATIONAL ACCOUNT FOR ROAD INFRASTRUCTURES

#### 3.1. Portuguese Road Tolls Calculation Schemes and Levels

The Portuguese toll system is based on the application of a very specific vehicle class classification. There are four vehicles classes according to the number of axes of the vehicle and its height measured vertically on the first axis (see Table 1). Heavy goods vehicles (HGV), to which the “Eurovignette” is applied, correspond to the Portuguese Class 4.

Tolls are calculated taking as base value the tariff per kilometer specified in the concession contracts for Class 1. The tariffs per kilometer for Classes 2, 3 and 4 are obtained multiplying the Class 1 tariff per kilometer by a factor, as shown in Table 1. Once the four tariffs per kilometer are calculated, the toll for a road stretch is calculated multiplying the tariffs by the stretch length and adding the legal VAT rate. The same factors are used in all concession contracts, and have no relationship with the weight of each class in the total expected traffic of a concession.

Table 1 – Vehicle toll classes in Portugal and classification criteria

| Vehicle Toll Class | Class Description  | Tariff Increase Compared to Class 1 |
|--------------------|--|-------------------------------------|
| Class 1            | Motorbikes and vehicles with a height lower than 1.10 meters, measured vertically on the first axis, with or without a trailer | -                                   |
| Class 2            | Vehicles with two axes and a height equal or higher than 1.10 meters, measured vertically on the first axis                    | x 1.75                              |
| Class 3            | Vehicles with three axes and a height equal or higher than 1.10 meters, measured vertically on the first axis                  | x 2.25                              |
| Class 4            | Vehicles with more than three axes and a height equal or higher than 1.10 meters, measured vertically on the first axis        | x 2.50                              |

The Class 1 tariff per kilometer specified in the concession contracts does not have a direct relationship with the cost parameters of each concession. The value is an update of historic values used since the 80s in concession contracts, which were calculated according to the principle of recovery of all costs incurred by a road concessionaire. The actualization of the value is done case by case, using the evolution of the Consumer Price Index (CPI) up to the moment the concession contract is signed. The figure below presents the actual average value of the toll per kilometer for the four classes in the Portuguese network. It can be observed that these values respect the conversion factors used in the calculation of the tariffs.

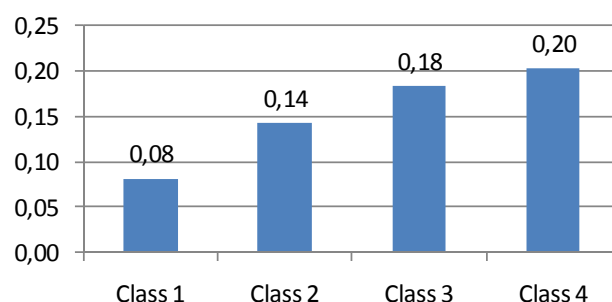


Figure 7 – Average toll (€/km) per vehicle class

The analysis of the Portuguese toll calculation scheme shows that tariffs, as the main instrument used for the remuneration of the real toll concessions, do not reflect any cost savings produced in the sector due to progress in construction technology, management tools, O&M techniques, etc. In other words, the system does not establish a relationship between the reality of the sector in terms of technological and managerial progress and its remuneration, only the evolution of the CPI.

Another important result is that tolls per vehicle class are not directly related to the physical and financial impact that each type of vehicle has on the infrastructure. It may be the case that some classes may be undercharged, and others overcharged, as tolls do not reflect the real cost caused by the vehicle while using the infrastructure.

### 3.2. Eurovignette-based Tolls Versus Portuguese Tolls

The Directive 1999/62/EC defines that the calculation of tolls shall be based exclusively on the principle of the recovery of infrastructure costs, and introduces the concept of “weighted average toll”, as the total revenue raised through tolls over a given period divided by the number of vehicle kilometers travelled on a given network subject to tolling during that period, both the revenue and the vehicle kilometers being calculated for the vehicles to which tolls apply.

The weighted average tolls shall be calculated taking into account the construction costs and the costs of operating, maintaining and developing the infrastructure network concerned. The weighted average tolls may also include a return on capital or profit margin based on market conditions.

One of the most relevant outputs of the NARI was the simulation of the values of the Portuguese tolls calculated applying the “Eurovignette” principles. The following figure presents the comparison between the maximum HVG toll calculated as a network mean value, according to the “Eurovignette” principles plus the legal VAT rate (21% in 2010), and the actual HGV tolls for the 157 road stretches that form the tolled Portuguese network, both expressed in €/vkm (being “vkm” vehicles-kilometer).

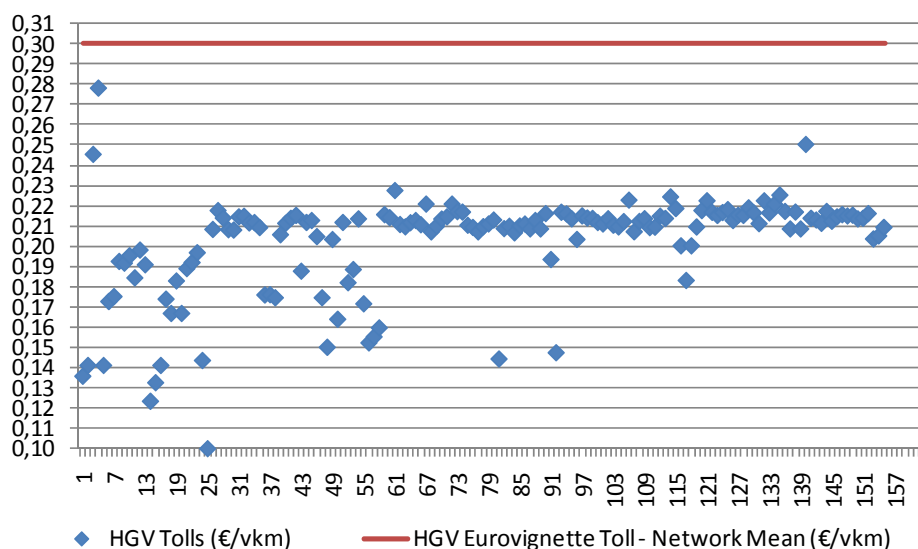


Figure 8 – Current heavy goods vehicles tolls and Eurovignette tolls for Portugal

An important finding is that all HGV tolls are lower than the maximum network value calculated according to the “Eurovignette” Directive, being the vast majority between 20 and 23 €cents/km. The average value of the current HGV tolls is 20 €cents/vkm (being 21€cents/vkm the median value), which means that tolls could be increased up to 50% and still comply with the maximum “Eurovignette” toll (30 €cents/vkm).

#### **4. CONCLUSIONS**

The INR launched in 2009 the NARI in order to improve its capabilities in certain technical areas related with its activity as regulator of the road concessions in Portugal. The project methodological framework is based in several EU studies of great relevance, being its primary goal to account for all costs and benefits of the road sector.

In the present situation, given the current economic and financial international conditions, there are important issues concerning the socioeconomic and environmental sustainability of the sector. The NARI tool provides useful outcomes to policy decision makers currently performing both the revision of the existing shadow tolls contracts in order to introduce tolls, and the revision of the PRN2000.

The NARI provides several interesting results from different perspectives: user costs, financial results of the concessions, social costs and benefits, and toll levels compared to the “Eurovignette” Directive dispositions. Concerning the road users perspective, it is worth remarking that real tolls amount just for 3% of the total road user costs, being time and congestion costs 58%. Taxes related to the use of the vehicles (fuel and vehicle taxes) amount to 13% of the total. From the perspective of the road concessionaires, in 2008 the aggregate revenues/costs ratio was under 90%, a total annual deficit of 400 million €. Finally, from a social perspective, it is important to highlight that the cash flows generated from the sector to the society amount for a positive net result of 1.8 billion € compared to total social costs, including monetised external cost.

The “Eurovignette” Directive is setting a path for more sustainable and fair road pricing schemes that will be broadened in the near future with the inclusion of external costs in the calculation of road tolls (namely congestion, pollution and noise costs). This can be a key factor for the future of the sector in Portugal, given the importance of PPP contracts for the development of the national motorway network.

At this moment, the remuneration of the real toll concessions in Portugal is based in a toll calculation scheme that does not relate directly the type of vehicle with the damage caused to the infrastructure and the subsequent financial cost. In the framework given by the current “Eurovignette” dispositions (and even more in the near future), if the calculation of tolls includes the external costs caused by the use of the infrastructure, the Portuguese toll calculation schemes will have to adapt rapidly. However, this change would only be applied to new or renegotiated concession contracts, being the real expected impact of the “Eurovignette” limited.

In this context, one of the main NARI outputs is the comparison of the current tolls with the expected value calculated using the “Eurovignette” guidelines. A major conclusion is that the current HGVs tolls are lower than should be according to Directive 1999/62/EC, which could mean that other vehicle classes are overcharged, thus existing a cross-subsidization between vehicle classes.

The implementation of a more sustainable and fair road pricing scheme in Portugal requires the application of the “Eurovignette” dispositions. However, the extent of the modifications introduced by the Directive is not yet fully known, as the transposition process is still undergoing.

## **5. REFERENCES**

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