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Can EIA improve energy performance of transportation?

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1. Introduction

Over the last two decades, motorization rate raised rapidly in Portugal: from 171 vehicles/1000 inhabitants in 1990 to 415 vehicles/1000 inhabitants in 2008 — more than a car per family, close to the UE-27 average of 470 vehicles/1000 inhabitants (IMTT, 2011). The weight of individual transportation increased correspondingly, fuelled by a swelling motorway system and low investment in public transportation. Individual transportation represents 85% of the modal split in land transportation in Portugal (% pkm), followed by buses with 10% and the railways with 5%.

Motorway extension in Portugal increased from 330 km in 1990 to 2 737 km in 2010 (INE, 2010) with a density of 30 km/1000 km^2, nearly twice the UE-15 average of 16 km/1000 km^2 (ECORYS Nederland BV, 2006). 233 road infrastructure individual projects were submitted to Environmental Impact Assessment (EIA) in Portugal between 1995 and 2011, of which only 91 were motorways.

Roadway infrastructure, especially motorways, cause a strain on natural resources, such as water, energy, materials and land use, negatively influencing the environment through air and water pollution, noise, habitat fragmentation, among others.

One impact that is very clear already is on energy efficiency in the transportation sector. The priority attributed to motorways implicate an undesirable modal split and exaggerated energy consumption in the Portuguese transportation sector, one of the least efficient as compared to other economic sectors in Portugal, and also one of the least efficient as compared with transportation in Europe. Transportation is responsible for 37% of final energy consumption and 26% of greenhouse gas emissions in Portugal (APA, 2011).

The overall goal of this line of research is to understand how the Portuguese motorway projects were developed, how were social, environmental, economic and political factors taken into account, and the relevance of the EIA in the decision-making process.

The research work is at a preliminary stage. The first phase, which is documented in this paper, consists in the analysis of evolution of the motorway network, motorization rate, traffic in existing motorways and alternatives.

2. Methodology

Research documented in this paper included the following steps:

a) Analysis of national statistics for transportation and mobility, related energy statistics and comparison with international indicators;

b) Inventory of road projects subject to EIA in Portugal since 1995 — this research yielded 233 processes;

c) Selection of case studies for more detailed analysis: only construction or enlargement of motorways were considered, yielding 91 processes corresponding to 26 major routes. This selection was caused by the following criteria: those are the larger routes both in extent and profile, so the ones whose construction caused larger impacts; many of them correspond to

major inter-city traffic, hence potentially larger operation impacts; many of them have parallel railway lines, therefore rail could be viewed at least partly as an alternative to road;

d) Analysis of the mode of alternative evaluations performed in each of the 91 EIA. Each EIA was classified according to the following level of alternative evaluation: (i) strategic alternatives — discussion of alternative traffic management measures, highway versus motorway, or rail versus road; (ii) differential alternatives — different corridors and/or limited discussion of profile; (iii) incremental alternatives — variant analysis over one corridor; (iv) no alternatives evaluation.

Work currently in progress comprehends:

e) More detailed review of the selected 91 EIA processes, gathering information on: (i) significance of impacts as predicted; (ii) compare predicted and actual traffic; (iii) investment cost; (iv) EIA post-evaluation and other follow-up studies;

f) In-depth review of selected cases with large discrepancies between predicted and verified traffic or impacts;

g) Cross information of expected impacts at project level with national statistics, and evaluation of effectiveness of impact mitigation at an aggregate scale;

h) Questionnaire to the 122 municipalities crossed by the national motorway network, inquiring on the benefits and damages caused by the motorway (out of 278 municipalities in Continental Portugal); about half have already answered and we expect that more will be filed in the next few weeks.

3. The national motorway network

Figure 1 shows yearly evolution of motorway extension (in operation) and road traffic of passenger cars. We can observe that the period with the quickest expansion of motorways was from 1997 to 2006, while the passenger traffic grows rapidly in the 90s and the first few years of the 2000s, but comes close to saturation before 2005 — at least four years before the economic crisis created a contraction in economic demand and thus in traffic.

Road traffic capacity and projected maximum speed depend on road geometry: width, inclination, turn radius, distance between nodes, among others. The most influential factor is the number of lanes; road profile is often described as 1+1 or 2+2 for the number of lanes in each direction. Portuguese regulations indicate that with an average traffic lower than 10 000 vehicles/day a 1+1 road profile is acceptable. An average traffic over 10 000 vehicles/day may warrant a 2+2 profile (most often a motorway with a project speed of 120 km/h), and a traffic over 35 000 vehicles/day warrants a 3+3 motorway (InIR 2011a).

There are no strict rules for intermediate options, but we suggest that below 20 000 vehicles/day, depending on traffic characteristics, solutions other than a 2+2 motorway may be acceptable: e.g. a 1.5+1.5 profile (meaning there is an overtaking lane in one direction or the other instead of continual 2+2 lanes), or a narrower 2+2 profile with more nodes, in both cases with reduced maximum speed (90 to 100 km/h). Such solutions may be interesting if we are in densely populated areas and/or outside major long distance itineraries, because they are usually significantly less expensive than the standard 2+2 motorway, and less demanding in geometry, thus generating significantly less environmental impacts.

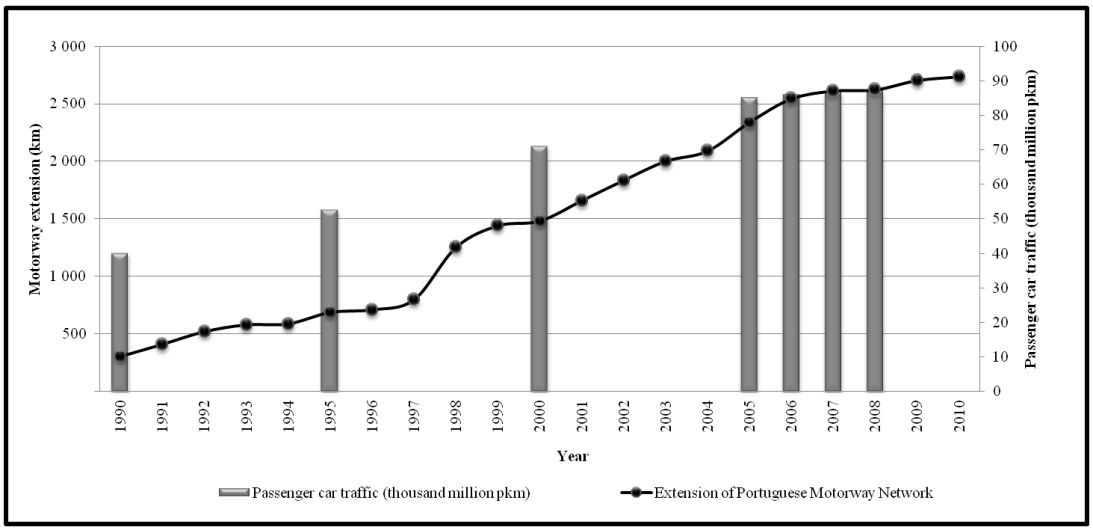

Figure 1 – Evolution of the Portuguese motorway network. Sources: INE, 2011; EC, 2010.

This discussion is relevant because a very large extension of motorways in Portugal shows an average traffic between 10 000 and 20 000 vehicles/day. Indeed, many have an average traffic well below 10 000 vehicles/day. This phenomenon can be observed in Figure 2, which shows average traffic in the thirteen longest motorways in Portugal, representing 94% of the total motorway extension in the country. In fact the graphic is kind to motorway use, because the figures shown are averaged over the total extent of the motorways; when we perform the same analysis by stretch, the excess capacity effect is even more pronounced. This is a work in progress; therefore, results presented here are preliminary.

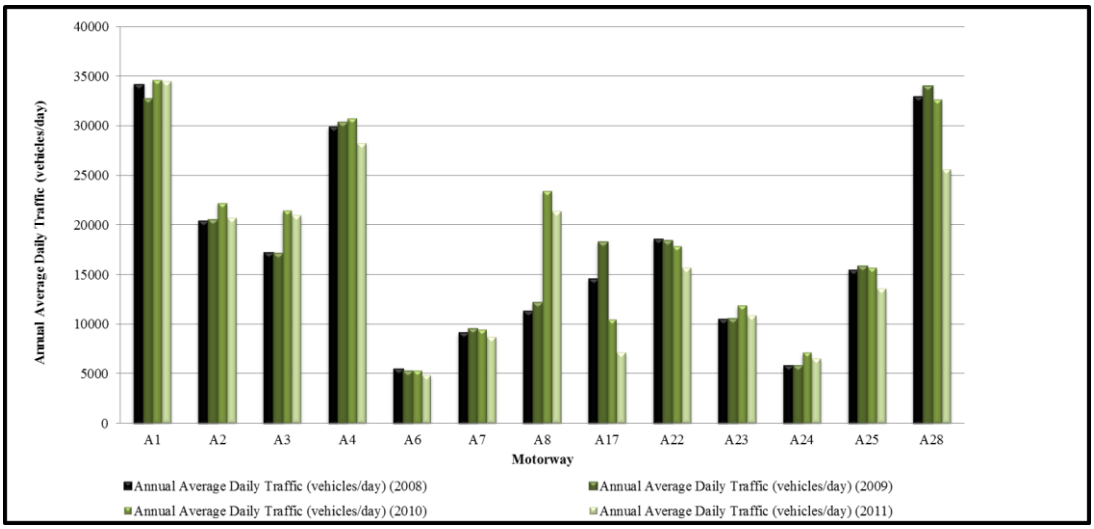

Figure 2 – Evolution of the motorway traffic, 2008 to 2010. Data from InIR, 2009, 2010 e 2011.

Three highways — A6, A7 and A24 — are below the 10 000 vehicles/day threshold. Seven more are close or below the 20 000 vehicles/day threshold. The inescapable conclusion is that, whatever criteria were used to approve many of those highways, realistic traffic estimates were not part of the decision-making.

This conclusion then begs the questions:

- Were there alternatives to the motorway, such as a narrower road profile or improvement of pre-existing roads? What about modal alternatives such as railways?
- Were those alternatives studied as part of the environmental impact assessment procedures? If not, why? If yes, why were they ignored in the decisions?
- What were the added impacts from the wider, speedier motorway and from the modal transfer

to private cars, enhanced by the motorway existence?

- What was the added cost of the uselessly wider motorway? Who benefited, and who suffered from this?

FEPICOP (2008) estimates that between 2008 and 2017 a total amount of 7 200 M€ was committed to investment in new roadways (most of it motorways). These new motorways are not included in previously referred statistics. Some of them have been suspended or cancelled as a deficit-control measure.

4. Alternatives to motorways

On paper, the Portuguese Government has repeatedly supported inter-modality (e.g. InIR 2011b). In practice, motorways have received by far the largest share of investment in transportation. It is not easy to compute exactly how much, because most of the investment in motorways has been under project-finance concessions to private investors. A rough estimate is that in the past decade investment in motorways was close to investment in all other modes of transportation put together.

Figure 3 shows how the EIS reviewed treat alternatives. The large majority (51%) considers only incremental variants on a base corridor. Only 3% report any kind of strategic or cost-effectiveness analysis.

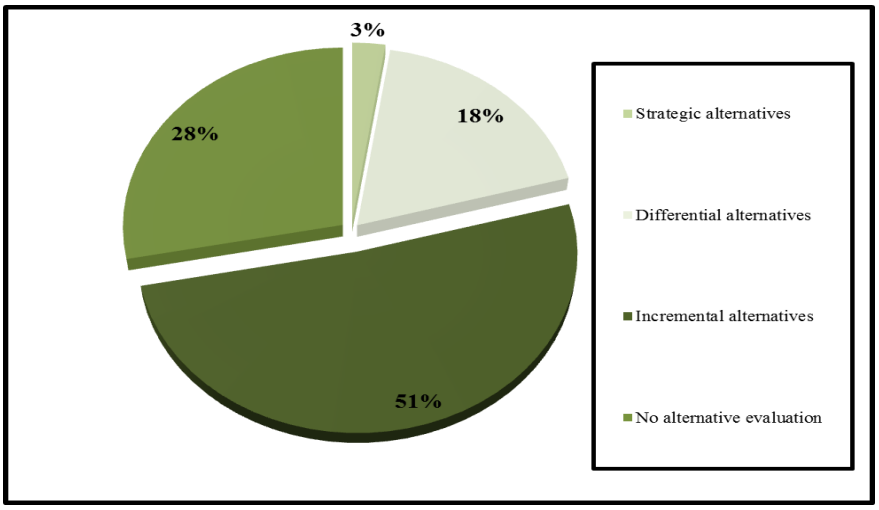

Figure 3 - Analysis of the study of evaluation of alternatives in 91 EIA (%)

Among the major motorways, nine are parallel to major railway lines, some of them already disabled, other being operated at substandard levels (Table 1); none of these has considered the hypothesis of totally substituting the motorway with better railway service.

Table 1 – Motorway and railway infrastructure overlap (source: MAOT 2005)

Route	Railway	Railways status	Motorway	km
Lisboa - Porto	Linha do Norte	Operative	A1	303
Lisboa - Albufeira	Linha do Sul	Operative	A2	241
Porto - Valença	Linha do Minho	Operative	A3	112
Lisboa - Évora - Caia	Linha do Alentejo	Substandard	A6	158
Lisboa - Leiria	Linha do Oeste	Substandard	A8	129
Leiria – Figueira da Foz	Linha do Oeste	Substandard	A17	117
Lagos – V.R.S. António	Linha do Algarve	Substandard/disabled	A22	132
Torres Novas - Guarda	Linha da Beira Baixa	Substandard/disabled	A23	215
Coimbra - Guarda	Linha da Beira Alta	Substandard	A25	196
			Total	1603

A preliminary analysis of the National Road Plan and of a sample of the 91 environmental impact statements for motorway works indicate that in the past twenty years railway was never considered as a real alternative. At most, in a very few cases, namely the river Tagus bridges at Lisbon, combined road and rail options were considered.

5. Conclusions

Over the last twenty-five years, transportation planning in Portugal has been directed mostly to motorway construction. Older motorways serve unequivocal transportation needs, but in the past decade new motorways and enlargement of old ones have become less and less useful. In all this period, inter-modality policy, although written on paper, was never applied in the field. The results are economical, social and environmental negative effects of motorway investments, including a negative contribution to energy use.

Preliminary results indicate that the study of alternatives in motorway EIA is often limited to route analysis, not taking into account other options (e.g. railways, different road profile), and no cost-effectiveness analysis. EIA application in these projects seems to be far from best practice, impoverishing significantly environmental and energy performance of the Portuguese transportation system.

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