Energy Policy 74 (2014) 486–498

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

The impact of the economic crisis and policy actions on GHG emissions from road transport in Spain

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HIGHLIGHTS

- Drivers contributing to GHG emissions of road transport are identified and analyzed.
- Decomposition analysis based on Modified Laspeyres Index (MLI) is applied to the Spanish case.
- Economic crisis and changes in mobility patterns and GHG emissions are analyzed.
- Policies for the decarbonization of road transport are recommended.

ARTICLE INFO

Article history:
Received 12 February 2014
Received in revised form
5 June 2014
Accepted 25 July 2014
Available online 28 August 2014

Keywords:
Road transport
GHG emissions
Economic crisis

ABSTRACT

Road traffic is the greatest contributor to the carbon footprint of the transport sector and reducing it has become one of the main targets of sustainable transport policies. An analysis of the main factors influencing greenhouse gas (GHG) emissions is essential for designing new energy- and environmentally efficient strategies for the road transport. This paper addresses this need by (i) identifying factors which influence the carbon footprint, including traffic activity, fuel economy and socioeconomic development; and (ii) proposing a methodological framework which uses Modified Laspeyres Index decomposition to analyze the effect of important drivers on the changes in emissions of road transport in Spain during the period from 1990 to 2010. The results demonstrate that the country's economic growth has been closely linked to the rise in GHG emissions. The innovative contribution of this paper is the special analysis of the changes in mobility patterns and GHG emissions during the economic crisis, when, for the first time, Spanish road traffic emissions decreased. The reduction of road transport and improved energy efficiency has been powerful contributors to this decrease, demonstrating the effectiveness of energy-saving measures. On the basis of this analysis, several tailored policy recommendations have been suggested for future implementation.

1. Introduction

Spain ranks fifth out of the 27 European countries in terms of energy consumption in the road transport sector and 12th in energy consumption per capita (EUROSTAT, 2013a). Impacts to the environment posed by road traffic, such as energy security and global warming, have been some of the main concerns in recent sustainable transportation policies. A sustainable transport system requires that the movement of people and goods occur in an environmentally, socially and economically viable way: mobility for any purpose constitutes a means rather than an end (WCED, 1987). Many transport strategies have focused on sustainable development. In the case of Spain, climate change mitigation measures in road transport have been applied through different energy-saving and efficiency strategies in recent years. The Ministry of Industry, Energy and Tourism introduced the National Energy Efficiency Strategy in 2004, which has given rise to three successive action plans. The current *Energy Saving and Efficiency Action Plan 2011–2020* (IDAE, 2011) aims to reduce the nation's total energy consumption by 20% by 2020; one-third of this target should be achieved by savings in the road transport sector.

The last few decades, however, have seen remarkable growth in road transport activity. In Spain, from 1990 to 2010, road passenger mobility (passenger-km) rose by 48.65% and freight transportation

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http://dx.doi.org/10.1016/j.enpol.2014.07.020
0301-4215/

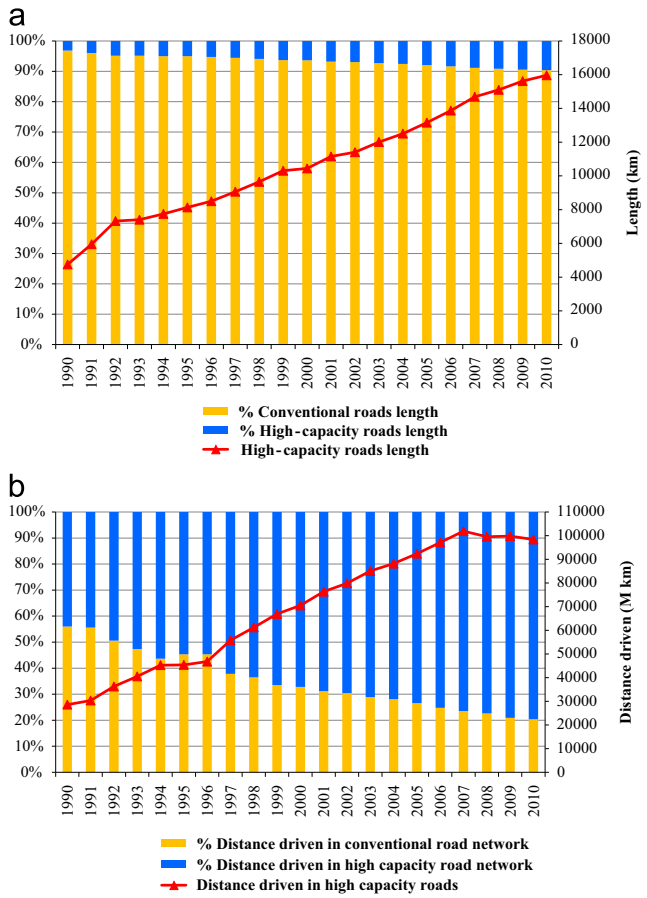

Fig. 1. (a) Spanish road network length; (b) distance driven by road type. . Source (MF, 2012)

activity (ton-km) increased by 64.8% (MF, 2012). This increase in traffic activity was marked by the expansion of the Spanish road network, especially high-capacity roads. The evolution of the network and the distances traveled on each type of road are illustrated in Fig. 1. Although the high-capacity road network represents only 10% of the length of the country's overall road network, the significant investment in road infrastructure has favoured the expansion of high-capacity roads over conventional roads (Fig. 1a). Indeed, in 2010, the total length of the high-capacity road network was 3.11 times that of the network in 1990, reaching nearly 16,000 km in 2010 (MF, 2012). This commitment to developing a well-established high-capacity network has led to an increase in the distances traveled on these routes (see Fig. 1b). Higher speeds, on the one hand, reduce trip times; on the other hand, however, this produces a rebound effect as vehicles travel greater distances, thereby increasing the overall energy consumption and GHG emissions. In fact, in 2010, the distance driven on high-capacity roads represented 80% of the total distance driven on the entire road network. Fig. 1.b shows that the distances driven on high-capacity roads increased substantially from 1997 to 2007, when they reached more than 100 billion kilometers annually. In contrast, there was a slight decrease from 2007 to 2010, with the most significant drop between 2007 and 2008.

The expansion of the network – especially of high-capacity roads – and the rise in demand for road transport have been followed by a respective increase in energy consumption and emissions. Road traffic remains the mode which consumes the most energy, representing 80% of total transportation energy consumption (ODYSSEE, 2012). Fig. 2 presents the evolution of total GHG emissions produced by the transport sector and those specifically linked to road traffic in Spain from 1990 to 2010. Despite the increase in transport emissions in absolute terms during this period, the share of road transport in the total national transportation emissions has remained steady at 90%. This confirms that the increase in transport activity was mainly produced by the expansion of road traffic. From 1990 to 2007 there was a continuous rise in GHG emissions in the road transport sector, with an average annual increase of 5%. From 2007 to 2010, however, there was a steady decline in emissions, with the most significant decrease occurring between 2007 and 2009. During these years, the effects of the crisis became more and more apparent; associated mobility of passengers and goods decreased, mainly due to the decline in working activity. Both of these factors were also significantly affected by the increase in oil prices during this period (ODYSSEE, 2012).

1.1. Review of previous studies of transport in Spain

The noticeable growth in road activity and GHG emissions over the last few decades justifies a detailed analysis of their explanatory factors. Previous studies analyzing the climate change impacts of road transport in Spain have considered all transport modes together. The majority of these studies were published after 2004, when energy-saving and sustainability policies began to be implemented on a wider scale. Pérez-Martínez and Monzón (2008) showed that there is a clear dependence on road transport in Spain. They argued that the increase in road traffic during the period from 1990 to 2005 was due to a rise in the motorization rate and in transportation demand, brought about by an increase in private mobility by car. Meanwhile, Mendiluce et al. (2010) identified the key factors driving the evolution of Spain's energy intensity levels using decomposition analysis. The results of their study show that the economic structure and strong transport growth have been the main factors driving the changes in energy intensity in Spain. Road mobility has demanded 50% more energy between 1995 and 2006, both in freight and passenger cars. The rise in passenger car use was caused by the increase in population and per capita income, urban sprawl and the dieselization of the fleet, which, while improving overall energy efficiency, had a rebound effect of increasing travel distances. For road freight transport, the main factors which have deteriorated the energy intensity were construction activity and an increase in the demand for short-distance delivery of supplies, which has raised light-duty vehicle use (Mendiluce et al. 2010). In the meantime, Pérez-Martínez (2010) analyzed trends in freight transport and GHG emissions in Spain from 1990 to 2007 using decomposition techniques. Freight transportation in Spain contributes to 8.5% of Spain's emissions and increased activity, the large modal share of road transport and economic growth are the main factors which have brought about this increase. In turn, Mendiluce and Del Río (2010) examined the determinants of passenger transport evolution in terms of energy dependence and GHG emissions. After the decomposition analysis, they concluded that the purchase of diesel vehicles has been the main driver of energy consumption for private car transport (influenced by per capita income). The total distance traveled per capita has grown significantly, with a consequent effect on energy consumption. While diesel vehicles offer better energy efficiency, this has not been enough to offset the growth of the transport sector (Mendiluce and Del Río, 2010). Mendiluce and Schipper (2011) then determined that transportation is the main contributor to Spain's emissions increase, which is mostly due to road-based transport modes. If energy efficiency has offered some benefits, these have not been enough to counter the dieselization of the fleet and the increase in traffic activity due to the rebound effect. The authors also highlighted the development of Spanish transport infrastructure and the heavy investment in