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A qualitative study about perceptions of European automotive sector's contribution to lower greenhouse gas emissions

Luís Morgadinho [a,*], Carla Oliveira [a,b], Ana Martinho [a,c]

[a] Department of Sciences and Technology, Universidade Aberta, Rua da Escola Politécnica, 141, 1269-001 Lisboa, Portugal
[b] Centro de Química Estrutural, Instituto Superior Técnico, Avenida Rovisco Pais, 1041-001 Lisboa, Portugal
[c] Le@d, Universidade Aberta, Rua da Escola Politécnica, 141, 1269-001 Lisboa, Portugal

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A B S T R A C T

This paper discusses the perceptions of some of the key stakeholders related with the European automotive manufacturers, automotive related industries – oil, tyres, electric batteries and information technology industries – and academia, about the technological contributions to lower greenhouse gas emissions of individual passenger vehicles. A qualitative approach, based on semi-structured interviews, was used in order to identify and explore possible relationships, causes, effects and dynamic processes. Technological and behavioural aspects were identified as crucial for the decrease of fossil fuels consumption and hence reducing carbon dioxide emissions. It was concluded that there is a strong focus on lowering the greenhouse gas and carbon dioxide emissions in the automotive sector and related industries concerning innovation process; furthermore there is a need for major stakeholders, including policy makers, to look at sustainable mobility using a more holistic and inclusive approach to achieve an effective delivery.

1. Introduction

Road transport contributes about one-fifth of the EU's total emissions of carbon dioxide (CO_2), the main greenhouse gas. CO_2 emissions from road transport increased by nearly 23% between 1990 and 2010, and without the economic downturn growth could have been even higher. According to data from the European Commission, transport is the only major sector in the EU where greenhouse gas emissions are still rising (EC, 2013a).

The world population had reached 7 billion people in 2013, and it is expected to reach about 9 billion by 2050 (United Nations, 2013). As a consequence of this growth in population and the desired improvements in the quality of life, it is anticipated that an increased fraction of the population will be mobile; clearly, the car is not the only segment of the ground transportation sector requiring action, but it is the part considered here. Sustainable mobility then becomes an important issue and numerous definitions can be found. One of these is the definition of sustainability that was put forward in the Brundtland report. An adaptation of these for sustainable mobility can be “The ability to meet society's desires and needs to move freely, gain access, communicate, trade and establish relationships without sacrificing other essential human or ecological values, today or in the future”, as given in *Mobility 2030: Meeting the challenges to sustainability* (WBCSD, 2004). The increasing urbanization of world population and the complexity of achieving sustainable mobility arises, in part, because many cities require reconstruction to accommodate mass-transit to reduce greenhouse gases (GHG) emissions, as well as the accommodation of alternative fuels and the reduction of fossil fuels with the advent of fuel technology improvements and the reduction of pollution.

Achieving sustainable mobility is a challenge owing to the complexity of the changes required to implement different options, for example, hydrogen fuel cells (Linssen et al., 2003; Moriatry and Honeery, 2008).

This work focuses on the technological developments of motor engines from some of the most relevant car manufacturers using fossil fuels, hybrid technology and electric engines, and aims to answer the question: what are the perceptions of automotive and related industries about their contribution in lowering GHG emissions? The views from energy suppliers, in particular, oil companies and the electric battery suppliers, about mobility demand and future developments are also part of the current research. The pollution reduction purpose encompasses the use of engines driven by fossil fuels and other low carbon fuels, as well as other aspects

* Corresponding author. Tel.: +351 918758012.
E-mail address: luis.morgadinho@landtime.pt (L. Morgadinho).

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such as information technology, namely deployment of the internet into the vehicles and the use of telematics; elements connected to tyre technology that will contribute to the efficiency of the vehicles are also considered. All these elements, individually considered or combined, contribute to a reduction in GHG emissions and compensate for the increase of mobility worldwide for passenger vehicles. The need to lower GHG, in particular carbon dioxide (CO_2) emissions, and the legislation imperatives will continue to stimulate automotive and related industries to pursue technological research and development.

The reminder of this paper is organised as follows: Section 2 concerns the literature review about the technological contribution of the automotive and related industries to lowering GHG and CO_2 emissions; Section 3 is concerned with the research methods; Section 4 presents the findings, Sections 5 and 6 are concerned with the discussion and conclusions, respectively.

2. Technological contribution to lower GHG and CO_2 emissions – automotive and related industries

In this section the focus is on the literature review and special attention will be devoted to the technological challenges and most critical features that yield to a reduction of GHG emissions for the automotive and related industries. Automotive manufacturers and related industries, such as the oil industry, tyre industry and Information Technology and Communications (ITC) were addressed.

2.1. Automotive industry

The automotive industry is probably the sector with the biggest challenge amongst all the industries that are related to the car mobility demand: the CO_2 emissions have to be reduced to 95 g by 2020 (EEA, 2012; ETI, 2013), but by 2015 it is expected that CO_2 emissions will reach 130 g CO_2/km. Fig. 1 shows data concerning CO_2 emissions. As pointed out by Fontaras and Samaras (2009), the 2015 targets "will be more difficult to realize" than those for 2020, but it should be borne in mind that "the potential of mild and full hybrid systems goes beyond 130 g CO_2/km but cost effectiveness is still a major issue that needs to be addressed" (Fontaras and Samaras, 2009).

This lower target spurred most companies on to implement new strategies and restructure their plants and workforce capacity, but some reservations remain about industry's capacity to achieve the imposed limit of 95 g CO_2/km (Fontaras and Samaras, 2009). While Renault and Nissan have elected for the electric vehicle as their solution to achieve zero emissions, other companies, such as BMW, Mercedes, Audi and Toyota, have followed the hybrid technology route (Seidel et al., 2005). General Motors and Opel pursue the concept of the extended-range electric vehicle (E-REV) and the hydrogen fuel cell vehicle (fuel cell electric vehicle, FCEV) (Eberie and Helmolt, 2010). It is noteworthy, the close cooperation between the energy companies, car manufacturers and a number of other partners that has been established to move forward and to improve engine efficiency, advancing performance at a lower emissions rate. Fuel cell and hydrogen propulsion are still seen as niche sectors due to the high costs, and system longevity, and infrastructure investment required (Aftabuzzaman and Mazloumi, 2011; Linssen et al., 2003; Seidel et al., 2005). Innovations by the automotive industry, and new technological solutions brought to the market, face the critical mass issue – without scale (Turton and Barreto, 2004) it is difficult to bring consumer prices down, particularly if one refers to the use of fuel cell onboard hydrogen generation vehicles, without the combination of gasoline or diesel (Linssen et al., 2003). The same applies to the investment and infrastructure required for a distribution network.

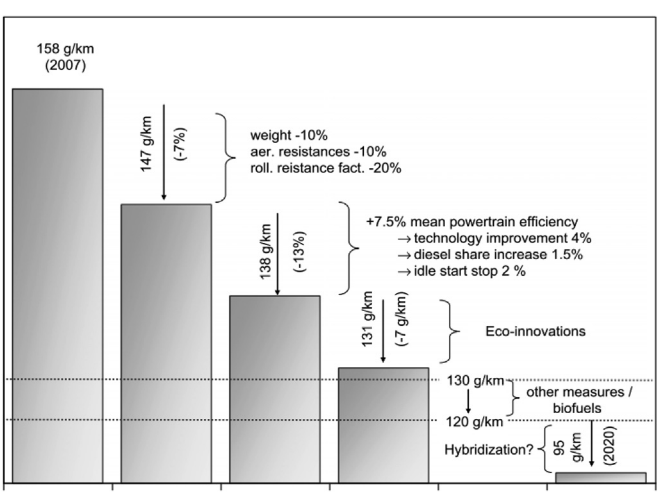

Fig. 1. Historical landscape of g CO_2/km and future objectives.
Adapted from Fontaras and Samaras (2009).

Table 1 gives a snapshot of the different power-trains such as: FCEV (Fuel Cell Electric Vehicle; BEV: Battery Electric Vehicle; PHEV: Plug-in Hybrid Electric Vehicle; ICE: Internal Combustion Engine) forecast for 2030 from three different viewpoints: performance, environment and economics and an opportunity assessment (Mckinsey & Company, 2012).

The *Well to Wheel analysis of Future Automotive Fuels and Power trains in the European Context*, a study done by the European Commission Joint Research Centre, EUCAR and CONCAWE, in July 2011, has concluded that large-scale production of synthetic fuels or hydrogen from coal and gas, offers the potential for GHG emissions reduction via CO_2 capture and storage, recognizing that further studies are required; in addition, advanced biofuels and hydrogen have a higher potential for substituting fossil fuels than conventional biofuels, though this solution requires high investment in infrastructure (production and distribution) (EC, 2011). These conclusions contrast with those reported by Romm (2006) who indicates PHEV as being the best intermediate solution to decrease by 30–50% the GHG and CO_2 emissions due to the flexibility offered by the dual capacity of using electricity and gasoline. The European Environment Agency monitors, every year, all automotive manufacturers in Europe with registration vehicles above 100,000 units comparing actual data, future projections and future targets.

2.2. Electric battery industry

Energy storage has always been one of the key challenges for the BEV's. From both the technological and cost points of view, Li-ion batteries are currently preferred over NaNiCl (Mierlo et al., 2006).

The current battery technology allows driving distances of between 150 and 250 km (Browne et al., 2012) for a medium size car, and requires 6–8 h for a full recharge if using normal recharging equipment, or 15–30 min for a partial recharge. A further reduction of the charging time impacts battery performance and potential degradation (Frenken et al., 2004). One of the major issues about electric vehicles is related to the battery's cost. Battery costs and battery development costs have a significant influence on the economic efficiency of an electric vehicle's total cost of ownership (Bikert and Kuckshinrichs, 2011; Mckinsey & Company, 2012).