Energy Policy 92 (2016) 359–368

Contents lists available at ScienceDirect

Energy Policy

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

Estimating road transport fuel consumption in Ecuador

Jaime Cevallos Sierra

Centro de Prospectiva Estratégica, Instituto de Altos Estudios Nacionales, Av. Amazonas N37-271 y Villalengua, esquina, 170135 Quito, Ecuador

HIGHLIGHTS

- The vehicle-kilometers traveled has been estimated from local info.
- The fuel economy has been calculated from national and international data.
- The groups with higher fuel consumption has been located.
- The fuel-type dependency has been estimated for each vehicle group.
- Greenhouse gas emission, and fuel costs, has been estimated for local road transport.

ARTICLE INFO

Article history:
Received 25 June 2015
Received in revised form
24 December 2015
Accepted 4 February 2016

Keywords:
Fuels
Latin America
Road transport
Vehicle-kilometers traveled
Fuel intensity
Subsidies

ABSTRACT

Road transport is one of the sectors with highest energy consumptions in the planet, with large dependence of fossil fuels, and contribution for global greenhouse gas emissions. Although, Latin America is not a high-energy consumer, its share in global consumption is expected to grow, especially in the transportation sector. This make essential for developing countries the adoption of better policies to identify the vehicle groups with largest fuel demands. The present study describes the VKT technique to disaggregate road transport energy consumption by vehicle type, applied to the road transportation system of Ecuador. It also describes the procedures performed to estimate the variables required to run the model, and some of the practical applications that be used to create public policies. Results show as the biggest fuel consumers the heavy-duty freight cargo, followed by light duty vehicles. The estimation of greenhouse gas emissions evidence that road transport released 14.3 million tons of CO_2 in 2012. When fuel consumption is compared by it costs, it can be confirmed that Ecuadorean Government covered, through subsidies, for 68% of the annual fuel costs of national road transport, demonstrating the importance of restructuring these expenditures in order to achieve an efficient road transport system.

1. Introduction

Current energy consumption in the transportation sector accounts for about one quarter of the global energy demand, and is expected to double until 2050 (IEA, 2012). Today, more than half of the energy demand of this sector takes place in OECD countries and China, though it is projected that developing countries increase their demands in nearby decades. Although most OECD countries have performed studies upon the sectors with highest energy demands, most developing countries have a lack of efficient methodologies for this purpose, causing gap of information for governments at the moment of performing decision-making. For this reasons, it is of great importance to calculate efficiently the energy demand of every energy-consuming sector in developing countries, especially in the transportation sector.

In Ecuador, the energy balance calculated each year by the Ministry Coordinator of Strategic Sectors (MICSE, for its acronym in Spanish) shows the transportation sector as the highest fuel consumer in Ecuador, and as observed in Fig. 1, it is gradually increasing its share. In year 2012, the total fuel consumption of the country was approximately 57 million Barrels of Oil Equivalent (BOE), where the most demanded fuels were: diesel oil, conventional and premium gasoline, kerosene and fuel oil. In the same year, the demand of the transportation sector accounted for about 77% of the total amount. Within the transportation sector, road transport is the most significant in terms of energy consumption, as it demands more than 80% of the total needs in the sector (MICSE, 2013). Therefore, to achieve control in the rise in total energy consumption of the country, it is necessary to generate better control policies in road transportation, especially in the groups of vehicles with higher consumption rates.

The share of the transport sector in the energy balance of Ecuador shows a steady growth over time, similar to the trend of

E-mail address: jaimec13@hotmail.com

http://dx.doi.org/10.1016/j.enpol.2016.02.008
0301-4215/

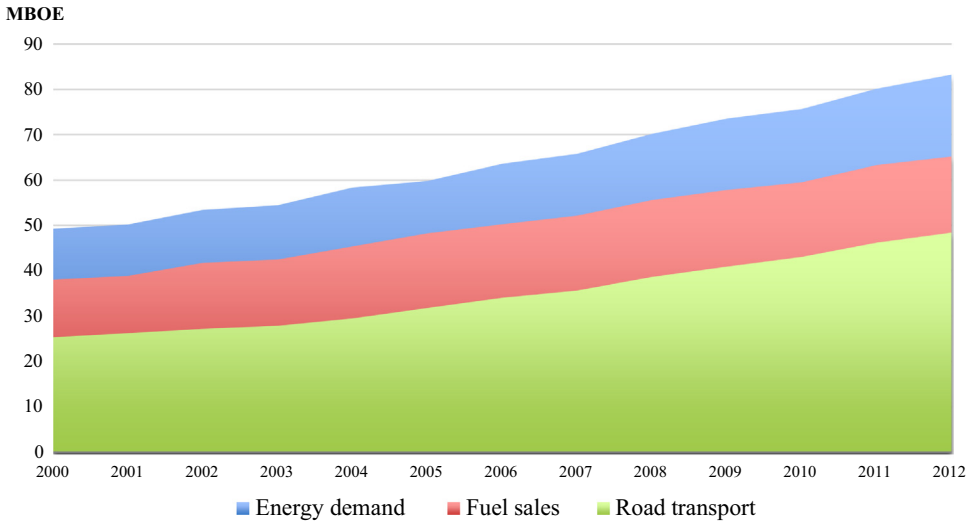

Fig. 1. Evolution of energy demand (MICSE, 2013).

the countrys stages of economic development (Lescaroux, 2011). Due to the importance of the road transport sector, the national energy balance includes a fuel consumption disaggregation by transport type (MICSE, 2013, 2014). However, this public company has not applied a standard methodology for this estimation, and some of the variables used have been collected from similar studies of other Latin-American countries, which unfortunately do not reflect the reality of the Ecuadorean transportation system. To date, there is no established methodology that focuses on the estimation of fuel consumption by road transport in Ecuador, or any other Latin American country. For this reason, the methods proposed in this study can be adopted, and used in the future to increase the understanding of the behavior of each group of vehicles in this sector in the region.

Once the model has been structured and implemented it can be used for various practical applications, such as the quantification of greenhouse gas emissions into the environment. This is the most common application of energy consumption estimation, which has been applied in various sectors of the countries with highest fuel consumptions, specially the transportation sector. In general, this type of study is applied to identify the contributors of energy pollution into the environment (Shipper et al., 1997).

Another application for such calculation is the regulation of fuel subsidies by typology of vehicle. Ecuador developed its subsidy policy in 1974, starting with the subsidy to diesel fuel; since then, it has been recognized as one of the countries with higher subsidies of fuels, caused by the goal of helping the poorest sectors of the country. In general a subsidy must meet three basic rules, as must it be: provisional, properly directed to the population to be benefited, and should benefit all participants related to the subsidy, such as the government and the population (Andrade, 2011). Unfortunately, most of the subsidies implemented in the country fail to meet those objectives, as most of them are misdirected and their benefits end up in higher income social sectors. In addition, various international organizations have demonstrated the importance of the removal of these incentives, as they are considered to promote global warming because of stimulating over-consumption and reducing the incentives to buy cleaner, and efficient, vehicles and energy systems (Flores, 2013).

Due to the importance of road transport in the energy metabolism of Ecuadorean society, this study seeks to disaggregate fuel consumption by type of vehicle, its use in society, and the fuel it consumes, in order to identify groups with greater demand and benefit on subsidies. The results of the analysis can be used for future studies of societal metabolism, *which can be used to identify the elements conforming society and their relations to the environment* (Giampierto et al., 2009).

The structure of the paper is organized as follows: After the introduction, Section 2 includes an extensive review of related studies, of energy consumption in the transportation sector, from different sources; Section 3 describes in detail the procedures performed to collect the necessary data required to run the model; Section 4 presents the results of the model, and shows some of its practical applications used for the benefits of the society. Finally, Section 5 presents the conclusions of the study and recommends various policies that can be applied to improve the efficiency of this sector.

2. Literature review

There are various methodologies to determine the road's fuel consumption in a given country. The selection of a suitable method usually depends on the statistical data available. Studies with similar objectives to this one have been carried out in various regions such as: North America, Europe and Oceania. However, these have adopted different methodologies to determine the behavior of its transport system, according to the availability of information. Literature review shows that the most effective methodologies to calculate energy consumption and GHG emissions are the decomposition methods, such as the Structural Decomposition Analysis (SDA), and the Index Decomposition Analysis (IDA) (Zhang et al., 2011). Ang reported in his study performed in 2004, a research of around 200 publications related to energy consumption, and marked out the preferred methodologies that have been applied for energy policymaking in various countries.

Among the transportation traffic estimation techniques, the VKT method has been widely accepted to estimate energy consumption and CO_2 emissions. Despite this method does not have the adequate accuracy, due to high uncertainty caused by motor and fuel type, road conditions, and driving expertize, it is the most used in the transportation sector (Cai et al., 2011; Wang et al., 2007; He et al., 2005). Several studies has used this methodology to perform decomposition analysis in the road transportation sector (Mraihi et al., 2013; Ou et al., 2010; He et al., 2005; Shipper et al., 1997), where the total fuel consumption in the sector is calculated by combining three components: (i) the vehicles population classified by a given criteria; (ii) the total distance