



Assessment of interstate freight vehicle characteristics and impact of future emission and fuel economy standards on their emissions in India



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ABSTRACT

Road freight in India plays a vital role in the economic growth of our country. Rising energy consumption and the environmental impacts by freight vehicles is constantly monitored through the introduction of stringent emission standards and through the promotion of fuel efficiency policies. However, little information is available on freight activity data (vehicle-kilometre) and their fleet characteristics (vehicle age, annual mileage, fuel economy etc.) to assess these policies. Therefore, the paper analyses the existing fleet characteristics in terms of age, annual mileage, fuel economy, fuel type used etc. for the freight vehicles used for “interstate” or “intercity” mobility on National Highways. Origin-Destination surveys and traffic volume counts are conducted at ten locations along major National Highways to capture the fleet characteristics. Based on the results, emission outlook for the proposed emission standards and fuel economy standards for freight vehicles is presented. Significant emission reductions are expected if emission standards are nationwide and timely implemented. Further, the requirement of country representative survival rates is highlighted.

1. Introduction

The transport sector is globally recognised as the backbone of economic growth. However, gradually concerns have been raised for its close association with the energy consumption and its related environmental impacts. Globally, transport sector accounts for 23% of CO₂ emissions. Within transport sector, 75% of CO₂ emissions are shared by automobiles and trucks travel (IEA, 2009). Sustainable and strategic planning for the transport sector has, therefore, been a growing thrust worldwide. Being a developing economy, in India, similar challenges have been realised and various policies have been implemented to combat the rising energy consumption and environmental emissions by the transport sector. India is facing an unfortunate recognition with 33 Indian cities among top 100 world's worst pollution affected cities (WHO, 2016). In fact, the health cost from air pollution constituted 23% of the total India's GDP value in 2010 (TERI, 2015). Emissions and fuel consumption from the road transportation has always been a focus of concern and is rather constantly monitored through the introduction of emission standards and through the promotion of fuel efficiency policies. Nevertheless, these worthy attempts have been marred by the increase in population, rapid urbanisation, rise in motorisation and limited investments in sustainable transport systems (Pucher et al., 2005). According to Census of India (2011), the population of India increased to 1210 million registering a decadal

growth of 17.64%. Meanwhile, the number of registered motor vehicles increased to 210 million with a compound annual growth rate of 9.8% between 2005 and 2015 (MoRTH, 2016). Aggressive growth rate both in terms of population and vehicles have, therefore, continuously challenged the balance between India's energy demand, air quality and overall development.

The transport sector in India contributes to 6.4% share in India's GDP of which road transport accounts for 4.5–5% share. In 1950s road transport carried 15% of passenger and 14% of freight movements with the total network length of 0.4million km. However, over the past two decades, road sector has evolved as a predominant mode of transport both in terms of the number of vehicles and road network length. This is evident from the fact that road transport now accounts for 86% of the passenger movements and 66% of freight movements with the total network length of 4.7 million km in 2011 (MoRTH, 2011) The rise in the share of road transport is attributed to its flexibility and adaptability in operation and is supported by massive investment in road infrastructure through government programmes like the National Highways Development Project (NHDP), Pradhan Mantri Gram Sadak Yojana (PMGSY) and Jawaharlal Nehru National Urban Renewal Mission (JnNURM).

As far as energy consumptions are concerned, the transport sector of India accounts for 14% of the final energy consumption and has been associated with the highest growth rate in terms of energy consumption

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(annually 6.8% since 2000) among other end user sectors (IEA, 2015). A significant component of the transport sector energy consumption is dominated by the oil-fuelled road travel by freight vehicles. PCRA (2013) also highlights that “Of the total diesel consumed by road transport, trucks and buses accounted for about 77% with buses consuming around 7.08 million tonnes per annum and trucks consuming 24.25 million tonnes per annum.” Further, Dhar and Shukla (2015) indicate a strong correlation between per capita freight demand and energy demand. The authors project the increase in freight demand with 8% GDP growth to increase from 1464btkm in 2010 to 5941btkm in 2050. Apart from the large proportion of oil consumption, freight transport has also attracted much concern due to the release of toxic air pollutants and greenhouse gases (GHGs). Ramachandra (2009) estimates that truck and lorries contribute to the highest proportion of vehicular emissions in India. Total emissions include CO₂ (28.8%), NO_x (39%), SO₂ (27.3%) and PM (25%). On similar line, the emission inventory for different cities in India suggests that diesel operated heavy and light-duty vehicles have the highest contribution to the overall emissions (Goel and Guttikunda, 2015; Guttikunda and Kopakka, 2014; Guttikunda and Mohan, 2014).

In spite of the vital role of road freight sector in the overall energy consumption and air emissions, the policy environment of freight vehicles in India has been quite sluggish in comparison to its counterpart—passenger transport. Road freight sector has seldom being involved at national level planning, eventually leading to some ad-hoc measures at the urban level to mitigate its negative impacts. For instance, the capital city of India, Delhi has introduced time and again different policies like time restriction, green tax and prohibition of freight vehicles greater than 15 years to curb city's air pollution. Besides these policy interventions, the benefit of these localised efforts still remains questionable. Therefore, at present, there lies a significant scope of nationwide efforts through the improvement of freight vehicle emission standards and fuel economy standards. Strict and timely implementation of these standards will consequently help to reduce fuel consumption, encourage technology advancements, reduce emissions and cut down energy demand. However, the paucity of freight activity data (vehicle-kilometre) and their fleet characteristics (vehicle age, annual mileage, fuel economy etc.) limits the analysis of the potential impacts of the key policy initiatives (CAI-Asia, 2011; Planning Commission, 2013). Unlike other developed countries, in India national travel or commodity flow surveys are not conducted on regular basis. The information is available through few occasional travel surveys conducted as a part of independent studies (Schipper et al., 2009). One of the attempts to estimate commodity specific interregional freight traffic was made in 2009 (RITES, 2009) where the main focus of the report was on estimating nationwide tonne-kilometre and its projections over years. No specific information regarding the freight characteristics is available through the study.

Taking into account the above facts, the present paper aims to analyse the existing fleet characteristics in terms of age, annual mileage, fuel economy, fuel type used etc. for the freight vehicles used for “interstate” or “intercity” mobility on National Highways. This includes the freight vehicles used for long distance transportation. Secondly, comparisons are made between observed freight characteristics to that of urban fleet characteristics available for the city of Delhi. Various studies available at the city level or national level are referred to for comparisons (Baidya and Borken-Kleefeld, 2009; Goel and Guttikunda, 2015; Gurjar et al., 2004; IISD, 2013; Pandey and Venkataraman, 2014; Ramachandra, 2009). Thirdly, implications of various assumptions used in the literature regarding these characteristics on the total amount of emissions are investigated for the base year, 2016. Also, based on the observed characteristics three emission scenarios are tested—(a) Business as usual- No improvements in the present emission standards (b) BS IV emission standards are introduced nationwide in 2017 (c) BS VI emission standards are introduced nationwide in 2020 after implementation of BS IV in 2017. Further, the

impacts of accelerated phasing of fuel economy standards are also explored.

The paper includes five sections. Section 2 discusses the timeline of fuel emission standards and fuel economy standards for freight vehicles in India. Section 3 deals with data collection methodology. Section 4 deals with the discussion of results and presents the emission outlook through years 2016–2026. Section 5 deals with policy implications and presents the way forward for the future work ahead.

2. Background fuel emission and economy standards - India

2.1. Fuel emission standards

Emission standards are formulated to lower emissions by effectively designing new vehicles as compared to the old fleet. India uses the European Union based “technology following” emission standards. Through this approach emission levels are reduced by the use of already demonstrated technology (Faiz et al., 1996). In 1992, for the first time emissions from diesel vehicles came under jurisdiction. Next revision in the emission standards came in the year 1996 which was followed by the adoption of Bharat Stage I standards (Equivalent to Euro I) in the year 2000. Subsequently, there have been progressive efforts to reduce the emission levels through the adoption of stringent emission standards. In 2003, an expert committee was constituted to chart out the roadmap for the emission standards in India on regular basis. In 2014, the committee submitted its second report on “Auto Fuel Vision and Policy, 2025 (2014)” and recommended to introduce BSV and BSVI emission standards by 2020 and 2025, respectively. However, realising the need for stricter emission standards the road ministry in 2016 decided to leapfrog directly from BSIV to BSVI emission standards nationwide by 2020. The emission standards for the freight vehicles is divided into two categories—light-duty vehicles (with gross weight less than 3.5 t; include all light commercial vehicles like three-wheeler, minivans used for commercial purpose and exclude passenger cars or minivans used to carry passengers) and heavy-duty vehicles (with gross weight greater than 3.5 t; includes medium and heavy duty trucks with 4-axle or more). Fig. 1 shows the reduction in the emission level of various pollutants (g/kWh) for diesel operated heavy-duty vehicles through the adoption of Bharat stage standards with time.

The emission standards for heavy-duty vehicles are quite different from light-duty vehicles. Where the light-duty vehicles follow the standards set for the passenger vehicles, establishing the emission standards for heavy-duty vehicles is a complicated task. Emission standards for heavy-duty vehicles are reported in terms of grams of pollutant per unit power generated by the engine (Engine-based certification) instead of grams per kilometre (Vehicle-based certification). Vehicle-based certifications may be more accurate than engine based certifications due to the fact that engine performance is strongly affected by the type of chassis it is paired with, vehicle size and fuel consumption. On the other hand, vehicle-based standards would

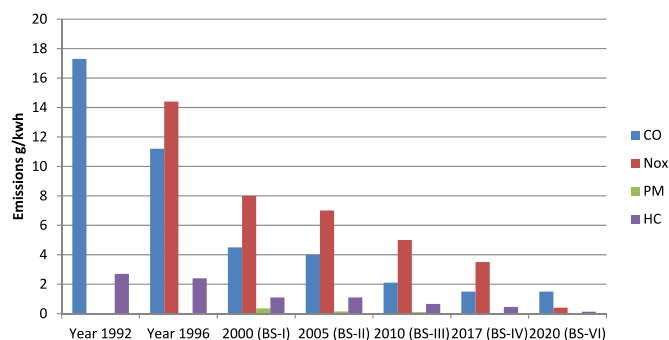


Fig. 1. Chronology of emission standards for heavy-duty vehicles (g/kWh) in India.

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