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Evaluating choice of traction option for a sustainable Indian Railways

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ABSTRACT

The transport sector is a major contributor of carbon emissions in India. As railways are the most environment-friendly mode of transport we look at the spearheading role of Indian Railway (IR) in bringing about the modal shift from road and airways to rail with a holistic perspective considering India's development stage and resource situation. India being an emerging economy, faces many other social and developmental challenges, which have to be incorporated in assessing the viability of the solutions. In order to assess the total impact of the transportation sector a 'wells to wheels' approach needs to be adopted to quantify the emissions from the production to distribution and final usages alongside its impact to the competing societal goals utilizing the same resources. This study focuses on evaluating IR's critical policy decision towards providing efficient transport i.e. the choice of traction. It is inferred that until such time the fuel mix of power production in India remains the same, i.e. coal dominated and there is a shortage of electricity in the country, the accumulated carbon footprints of running electric locos will be higher. There should be a judicious mix of both the tractions to achieve a balance in environmental efficacy, sustainability and equity.

Introduction

India is home to about one third of the world's population and is confronted with various social and economic issues like poverty alleviation, provision of electricity and clean drinking water to the people. To meet the above goals India needs to grow @7–8% for the next two decades and this implies commensurate energy requirements that have to be met in a sustained manner. There is pressure on the scarce financial resources for these competing and often conflicting demands as against the additional expenditure for low carbon strategies. As India is a developing country and the resources are limited the impact of choice of traction also affects the electricity dynamics of the country which is woven to the social and economic development of other sectors. In this paper, the option of choice of traction for IR has been assessed with respect to technical, economic and societal perspectives for India.

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Global emission scenario

In 2009, India signed the Major Economic Forum (MEF) declaration and agreed for voluntary emission cuts and in 2010, an expert group was set up to guide India on a path of a low carbon economy. At the international level, India has been instrumental in development of the climate change norms and rules and in 2010, it accounted for 20% of all the Clean Development Mechanism (CDM) projects registered worldwide under the United Nations Framework Convention on Climate Change (UNFCC). Being an emerging economy and with the increase in its energy requirements its emission of Green House Gases (GHG) are likely to go up in the future. Although the per capita CO_2 emissions in India are amongst the lowest in the world, yet during the period 1990–2004 emissions have grown by 97% (Sengupta, 2012, 9). Inspite of all the initiatives India ranks 155 out of 178 countries based on the environmental performance index 2014(EPI). This indicator has various sub indicators like health impacts, air quality, water and sanitation, water resources, agriculture, forest, fisheries, biodiversity and habitat and climate and energy. If we look specifically at the climate and energy indicator which assesses mitigation action and access to energy relative to a country's level of economic development, India is ranked 104. China which has far higher emission levels and growth rate is ranked 21 and this shows that India needs to do a lot in this direction of cleaner and sustainable development (University, 2014) (see Fig. 1).

Transport and climate change

Growing usage of transport is causing long term damage to the climate. It is leading to an average increase in the production and consumption of fossil fuels. Oil is the dominant fuel for transportation and road transport consumes 81% of the total energy used in the transport sections (WBSCD, 2001). The transport sector contributes 23% towards global CO_2 emissions. Out of this Asia accounted for 19% of the emissions in 2006 and this was expected to increase to 30% by 2030 (Regmi and Hanaoka, 2011). About 76% of the CO_2 emissions from a car are caused by fuel usage, 9% from manufacturing and the balance 15% from losses in the fuel supply chain, as has been indicated by Potter (2003). The freight carried by road, which typically account for half of the traffic transported by road, is the largest contributor for environmental pollution and this is followed by use of cars by individuals. The aviation sector is far more polluting as it discharges GHG's directly into the atmosphere; however, the traffic carried by this sector is limited. These sectors, however, are growing faster than the other modes thereby worsening the situation (Chapman, 2007). In order to assess the total impact of the transportation sector a 'wells to wheels' approach has been adopted to quantify the emissions from the production to distribution and final usages (Johansson, 2003; Mizsey and Newson, 2001; Weiss et al., 2000).

Indian carbon emissions scenario-sector wise

In India, the power sector generates about 38% of the carbon emissions (Fig. 2) as most of the electricity generating plants are coal and gas based. It is expected that the energy mix in the power production will remain the same even in 2020 and

Region	Pop. (mill.)	GDP (billion 2005 US$)	GDP ppp (billion 2005 US$)	Total Prime Energy Supply (MTOE)	CO2 Emissions (MT CO2)	CO2 Emisions from elect. Gen. (CO2 in gms/kWh)	Electricity output (Terawatt hours)	PerCapita CO2 Emission (tonnes)
World	6958	52485.9	70313	13113.4	31342.3	536	22125.8	4.5
China	1351.2	4425.8	10286.3	2742.6	7999.6	764	4754.7	5.92
Brazil	196.7	1126.7	2021.3	270	408	68	531.8	2.07
India	1241.5	1317.5	3976.5	749.4	1745.1	856	1052.3	1.41
Japan	127.8	4622	3932.2	461.5	1186	497	1042.7	9.28
S. Africa	50.6	298.1	489.6	141.4	367.6	869	259.6	7.27
UK	62.7	2386.6	2063.3	188.1	443	441	364.9	7.06
USA	312	13225.9	13225.9	2191.2	5287.2	503	4326.6	16.94
France	65.1	2249.1	1958.7	252.8	328.3	61	556.9	5.04
Germany	81.8	3048.7	2828	311.8	747.6	477	602.4	9.14
Russian Fed.	141.9	947.2	2103.5	731	1653.2	437	1053	11.65

Fig. 1. Comparative Emission Statistics Source: IEA statistics 2013.