INDIA

ROAD TRANSPORTATION

Policies for low carbon pathway and role of non-state actors in India

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An efficient transport system is crucial for India as it witnesses rising demand for transport services and related infrastructure. As mobility needs of the country are increasing, the subsequent impacts are also intensifying. With road transport sector becoming one of the major contributors towards GHG emissions, air pollution, congestion and several other negative externalities, various policy measures are being implemented to make the sector more efficient. Coordination and collaboration between government policies and actions of non-state actors in the form of awareness campaigns, capacity building initiatives and policy research can strengthen the implementation of these policy measures. To this end, the focus of this study lies on how efforts of non-state actors are aligned towards promoting low-carbon road transport sector in India. We will focus here only on normative and technical developments in road transport, bearing in mind that urban development and the development of public transport remain essential for the stabilization of emissions from the sector.

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CONTENTS

1 • ROAD TRANSPORT SECTOR : AN OVERVIEW

Transport plays a vital role in the path of economic development; by moving passenger and goods, it fosters personal & economic growth (United Nations, 2016). Hence, the provision of a safe, sustainable and efficient transport system becomes crucial for a growing economy like India. The transport system in India consists of diverse modes such as rail, road, shipping, civil aviation, inland water transport and pipelines. India has one of the largest and densest roads and rail network in the world and transport in the country is dominated by rail and roads (World Bank, 2011) Transport demand in India is primarily driven by population growth and increase in economic activity. As India's population is expected to exceed that of China by 2024 (UNDESA, 2017), this coupled with increasing industrial and commercial activities will bring about a rapid transition in the way people and goods move.

Over the past few decades, better installed infrastructural capacity, focussed policy and investments have led to rapid expansion of road transport in India (NTDPC, 2014). Road network in India consists of National Highways, State Highways, District Roads, Rural Roads, Urban Roads and Project Roads. National Highway (NH), the principal network connecting metropolitans and major cities has played a pivotal role in the development of road transport sector in the country. **NH constitutes less than 2% of the road network but carries more than 40% of the total traffic volume** (NHAI, 2017).

Road transport sector has always held a dominant share of total traffic flows in the country with the sector currently accounting for 90% of the passenger movement and 67% of the freight movement (MoRTH, 2016). Statistics from the Road Transport Year Book (2016) reveals that between 2005-06 and 2015-16, the total tonne kilometres by road increased at a CAGR of 11% while total passenger kilometres increased at a CAGR of 14% (Figure 1).

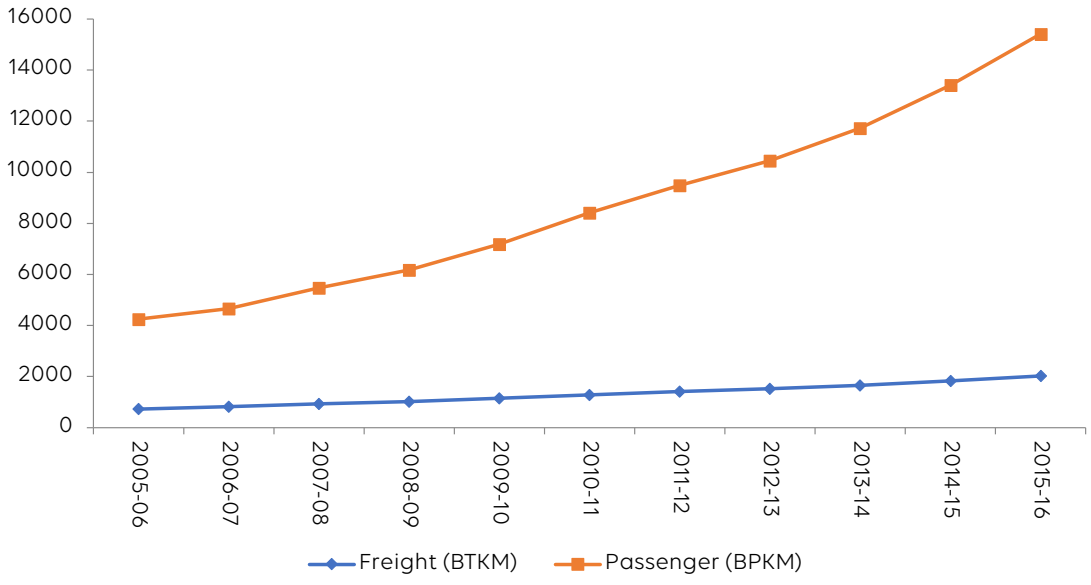

FIGURE 1. FREIGHT AND PASSENGER MOVEMENT BY ROADS

(Source : MoRTH)

Urbanisation is also a key factor that has contributed to rapid motorisation (IUT, CSTEP, 2014). As more and more people have moved to urban areas in search of economic opportunities, the demand for motorised transport has increased. As per the Census data 2011, Indian urban population increased at a rate of 31.8% over the decade and accounted for a share of 31.6% in the total population of the country. Reaching a figure of 230 million in 2016, motor vehicles in India grew at a CAGR of 9.9% between 2006 and 2016 (Figure 2) (MoRTH, 2016). An increase of urban

agglomerations/million plus cities in the country from 35 in 2001 to 51 in 2011 has led to higher proliferation of motorised vehicles in these cities with them comprising 31% of the total registered motorised vehicles in the country. Growth of cities and changing land use pattern has resulted in urban sprawl which has led to increased travel demand. A large share of this travel demand has been met by high ownership of two wheelers and cars which at present account for 86.6% of the total registered vehicles in the country.

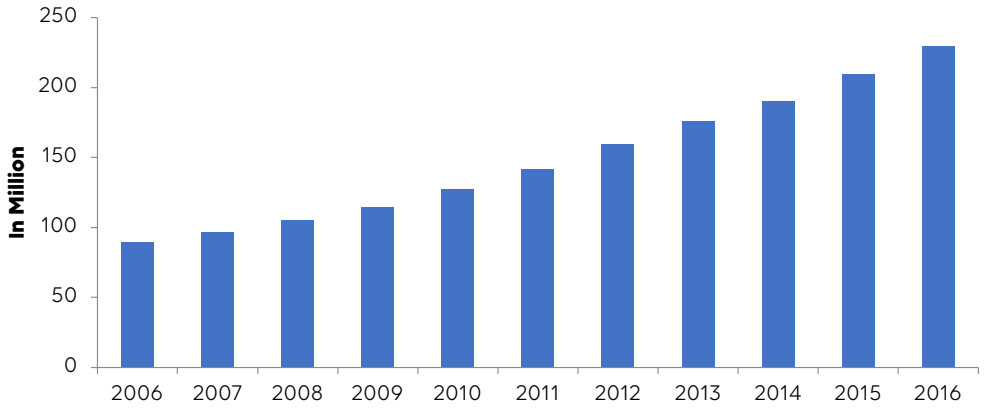

FIGURE 2. TOTAL NUMBER OF REGISTERED MOTOR VEHICLES

(Source : MoRTH)

2 • TRANSPORT DEMAND : IMPLICATION ON ENERGY AND EMISSIONS

Increase in transport demand has made the transport sector as one of the most energy intensive sector in the country. **Presently, the transport sector accounts for 24% of the total energy consumption in the country (TERI, 2018) and 98.5% of which is met by petroleum products (TERI, 2016). India's transport sector accounts for 99.6% of the total petrol and 70% of the total diesel consumption in the country (Nielsen, 2013). As per estimates by the International Energy Agency (IEA), India's transport sector accounts for almost 3% of the total transport sector fuel consumption in the world.** Between 2005 and 2015, India's transport sector fuel consumption grew at a CAGR of 8.3% from 38.8 million tonnes of oil equivalent (MTOE) in 2005 to 86 MTOE in 2015 (Figure 3). While over the same period, the world transport fuel consumption grew at a CAGR of 2% from 2212 MTOE to 2704 MTOE.

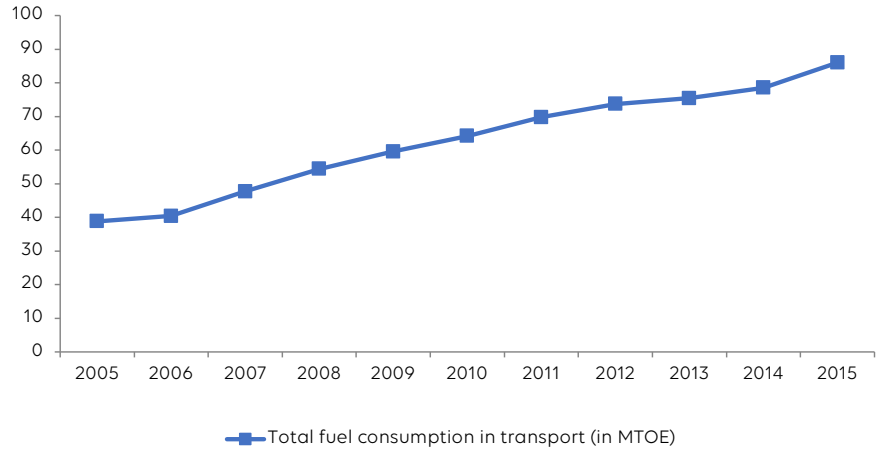

FIGURE 3. FUEL CONSUMPTION BY TRANSPORT SECTOR IN INDIA

(Source : IEA)

In India, transport sector accounts for 10% of the total Green House Gas (GHG) emissions [1] (MoEF,

GoI, 2015). Since, a predominant share of the transport sector's energy requirements are met through conventional fossil fuels like petroleum and diesel, the emission intensity of fuel combustion in the sector has increased from 10.5% in 2000 to 11.5% in 2014 (World Bank, 2018)[2] . **Transport sector in India accounts for 13.2% of the total CO_2 emissions from fuel combustion across sectors in the country, of which road transport accounts for the highest share of 87% (UIC/IEA, 2016).**

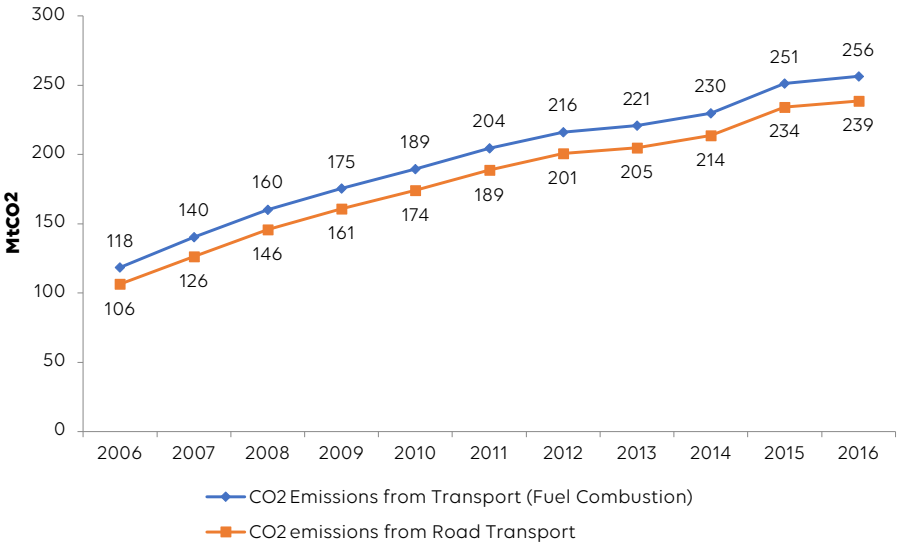

FIGURE 4. CO_2 EMISSIONS FROM FUEL COMBUSTION IN TRANSPORT SECTOR IN INDIA

Source : Enerdata

At the current rate of growth, this manifold increase in road transport demand can have huge implications on the overall energy demand of the sector and the concomitant emissions. India's CO_2 emissions are projected to triple by 2040 from 2013 levels if sectoral policies to manage energy demand are not put in place (Busby & Shidore, 2017). Considering the high reliance of the sector on fuel consumption coupled with India's high import dependence of crude oil (83% of total oil consumption) it is imperative to plan for sectoral policies that can manage fuel and energy demand from the sector in the coming decades and can influence the future carbon emissions (Pal, Singh, Wilson, & Joshi, 2015).

In this context, mitigation and adaptation strategies in the transport sector will play a significant role in achieving the Nationally Determined Contributions (NDCs) targets, which represent a unique opportunity for India to scale down its emissions and energy consumption. Under the NDCs a set of strategies to reduce the emissions intensity of its GDP by 33%–35% below 2005 levels by 2030 has been developed (UNFCCC, 2015). To this end, India is focusing on several mitigation initiatives to develop energy efficient and low carbon transport systems to reduce emissions from the transport sector.

With an objective of promoting energy efficient low carbon growth of the road transport sector, government has introduced several policies and programmes across passenger and freight segments. In terms of fuel quality and vehicle emission standards, India lags behind the international standards (NTDPC, 2014). Hence, the major focus of the policies in the road transport segment is towards improving vehicular technology through the implementation of progressive fuel efficiency norms, emission standards, electrification and bio-fuel blending. Adoption of these policies will lead to significant fuel savings and emission reduction, thereby promoting a low carbon and sustainable future for the road transport sector.

However, in order to realise the vision of a sustainable and low carbon road transport sector an effective engagement of concerned stakeholders is necessary. In this regard, initiatives by

1 - In terms of CO_2 equivalent
2 - Global emission intensity from transport sector decreased from 22% to 20.4% between 2000 and 2014

non-state actors such as Central Road Research Institute (CRRI) a premier national laboratory, and also a constituent of Council of Scientific and Industrial Research (CSIR), engaged in carrying out research and development projects for transport , Automotive Research Association of India (ARAI) a co-operative industrial research association by the automotive industry under the Ministry of Industries, Government Of India, Society of Indian Automobile Manufacturers (SIAM), the apex industry body representing automobile manufacturers in India, other industrial & technological research organisations, corporates and policy think-tanks to cut down emissions are becoming increasingly significant. **While the Government of India has planned a policy roadmap for the sustainable movement of passenger and freight, the successful implementation and adoption of these policies will be significantly determined by the actions and contributions of the non-state actors.** To assess the role of non-state actors in achieving a low carbon pathway for the road transport sector, it is first important to understand the current policies aligned towards achieving it.

3 • INITIATIVES TO DECARBONIZE ROAD TRANSPORT SECTOR

• ELECTRIC MOBILITY • Globally, electric mobility has emerged as one of the most aspiring solution towards the development of sustainable transport solutions. This is primarily due to increasing costs of energy, depletion of fossil fuels and rising emissions (DHI, 2012). Regulatory interventions by governments to promote zero-emission vehicles have also led to the shift towards Electric Vehicles (EVs); with zero tail-pipe emissions and long term economic viability, worldwide EVs are proving to be a favourable alternative technology solution (ASSOCHAM, EY, 2018).

India being a fast growing economy is also experiencing a rapid increase in transport demand for moving people and freight over distances. This increase in transport demand is largely being met by road transport which is highly energy intensive. High demand for petroleum products by road transport sector has subsequent economic, environment and social implications in the form of rising oil import bill, energy costs, depletion of fossil fuels and rising emissions. Hence, faster adoption of EVs is one of the policy interventions that Government of India (GoI) has taken to increase the efficiency of transport sector and to mitigate the adverse economic and environmental impact from the sector.

The history of electric vehicles in India dates back to 1996, when 400 EVs were made and sold by Scooters India Ltd. Bharat Heavy Electricals (BHEL) also developed an electric bus in 2000 and with support from government 200 electric vans were built in Delhi. However, the major leap came in 2001, with the introduction of REVA, an electric car which was more efficient and consistent than the earlier vehicles. The major concerns with respect to mass adoption of electric vehicles were high cost of charging, charging infrastructure, low battery life, etc. (DHI, 2012). Hence, in order to promote the mass and faster adoption of EVs in India, GoI launched the National Electric Mobility Mission Plan (NEMMP) 2020 in 2013 and the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME India) scheme under it. As part of the scheme, subsidies were introduced to promote the sales of electric and hybrid vehicles. Till date, the implementation of the scheme has led to 77000 tonnes of CO_2 emission reduction and 31 million litres of fuel savings (DHI, 2018).

Initiatives by Start-ups :

In 2015, in a move to make Bangalore's air cleaner, Lithium Urban Technologies, entered the EV domain. Lithium is a B2B organisation and is India's first electric cab service. With a fleet of 200 vehicles, it saves nearly 11 tonnes of carbon emissions everyday by covering a total distance of 60,000 kilometres. In order to run these pollution free vehicles, the company has also setup 200 high-speed charging stations around the city (The Better India, 2017).

TEXT BOX 1

In order to spearhead the adoption of electric vehicles in India, an investment outlay of INR 795 crore was approved under FAME-I for technology development, infrastructure creation, boosting demand through subsidies and pilot projects (ASSOCHAM, EY, 2018). Government has also selected 11 cities to ensure the penetration of EVs in public transport (Buses, three-wheelers and taxis) for several pilots (PIB, 2015). **The implementation of electric mobility in India is further being expanded by collaborative and coordinated actions of the governments, non-state actors and private sector players. Automobile manufacturers such as Mahindra and TATA through their partnerships with the central and state governments' are facilitating the implementation of policy frameworks**. To support the eMobility awareness campaign of the State of Karnataka, Mahindra Electric (pioneer of electric vehicles in India) along with Baghirathi Group (shared mobility service provider) deployed a fleet of 50 electric cars with an additional investment announcement of INR 400 crore over five years. With an aim to promote low carbon, zero emission and sustainable mobility solution, the Baghirathi Group also plans to deploy 1000 Mahindra electric cars for corporate mobility (Mahindra & Mahindra Ltd., 2018). In a similar move towards reducing the country's carbon footprint, Tata Motors signed a MoU with the state of Maharashtra in India to support the state's EV Policy. As a part of the collaboration, Tata will deploy 1000 EVs across passenger and commercial segment and will also setup 100 EV charging stations in the state (Tata Motors, 2018) (ET, 2018).

Apart from the private vehicle segment, government is also introducing EVs in multi-modal public transport. **In 2017, Nagpur became the first city in India to launch the electric mass transport project in India. The pilot was launched in collaboration with Mahindra Electric, Kinetic Green Energy and Power Solutions and Ola.** A fleet of 200 electric vehicles was procured, out of which Mahindra Electric manufactured the 100 'e20' electric taxis and Kinetic Green Energy and Power Solutions supplied 100 e-rickshaws and Ola, a cab aggregator provided the service platform for running the vehicles. Ola also built four charging stations having 53 charging points to power the fleet of 200 e-vehicles (live mint, 2017).

In 2018, Centre for Study of Science, Technology and Policy (CSTEP) which is a private policy think tank along with support from Shakti Sustainable Energy Foundation (SSEF) developed an e-bus fleet implementation plan for Bengaluru. As a part of the study, a detailed route analysis was conducted to identify suitable routes for installing Electric Vehicle Supply Equipment (EVSE) and charging infrastructure. An analysis of transport and electricity distribution was also carried out along with Bangalore Metropolitan Transport Corporation (BMTC) and Bangalore Electricity Supply Company (BESCOM) (CSTEP-SSEF , 2018).

Eco-friendly Intermediate Public Transport (IPT)

In a move to bridge the gap of first and last mile connectivity e-rickshaws were launched by the Delhi Government in the year 2010. Since then, e-rickshaws have gained tremendous popularity in the city and have increased from 4000 units in 2011 to 0.1 million units in 2015 (CEED, 2017). In order to further promote the uptake of these battery-operated vehicles, Delhi Government has also initiated the process of providing subsidies of INR 30,000 to drivers for retrofitting the old vehicles and registration of vehicles (ET, 2016).

TEXT BOX 2

• IMPROVED FUEL TECHNOLOGY STANDARDS • Globally, one third of the oil demand and around 50 per cent of all the transport related GHG emissions are accounted by passenger cars, two-wheelers, three-wheelers and light commercial vehicles (ICCT, 2018). Growth in road-based transport makes energy management in the transport sector a challenging task (AITD, 2000). Hence, adoption of vehicle based norms can play a crucial role in determining the future energy demand of

any country. Considering the fact that demand for automobiles in India will remain strong and will subsequently impact country's energy security and climate mitigation strategy, the Government of India through its Auto Fuel Policy has recognised the importance of regulatory measures such as fuel economy norms and progressive emission standards (Ministry of Heavy Industries & Public Enterprises, 2018).

• Fuel Efficiency Norms

In April 2017, Ministry of Road Transport and Highways (MoRTH) came up with first set of fuel economy norms for Light Duty Vehicles (LDVs) in passenger segment. These standards are based on Corporate Average Fuel Economy (CAFE) norms and define the targets in terms of fuel consumption in litre/100 km. In order to ensure compliance, these standards are converted into CO_2g/km for petrol, diesel, Liquefied Petroleum Gas (LPG) and Compressed Natural Gas (CNG) passenger vehicles with Gross Vehicle Weight (GVW) under 3.5 tons. The policy will lead to continuous reduction in CO_2 emissions through setting the efficiency standards for new vehicles at 130g/km in 2017 and 113g/km in 2022 for every automaker (TransportPolicy.net). **As India is expected to have highest number of cars on road in the world by 2050 (SSEF) and with rapidly increasing sales, India is presently the fourth largest automobile market in the world (ET, 2018)**. In view of the fact that India's future transport demand will be largely driven by cars, the efficiency standards for LDVs are expected to reduce CO_2 emissions by 50 million tons by 2030 (UNFCCC, 2015) and will achieve energy savings of 22.97 MTOE by 2025 (BEE, 2017). However, to achieve significant impacts, energy demand management of the remaining modes of passenger and freight segment also need to be addressed simultaneously, (AITD, 2000). Apart from this, it is also expected that India's demand for High-Speed Diesel (HSD) will increase from 76 million metric tonnes (MMT) in 2016-17 to 110.8 MMT in 2021-22. Since 38% of this demand is accounted by commercial vehicles, an absence of regulatory measures in this segment of vehicles can have serious implications on India's energy security (Nielsen, 2013).

Considering that Heavy Commercial Vehicles (HCVs) account for more than 50% of the CO_2 emissions from road transport in India, several research entities are focussing on the regulatory framework for fuel efficiency norms for HCVs. The Energy and Resources Institute (TERI) undertook a study to develop pathways for the adoption of fuel efficiency in HCV sector in India. The study exhibits several methodologies to formulate fuel efficiency standards and also identifies various technologies available for improving the fuel efficiency. The aforementioned study was carried out with support from SSEF which works collaboratively with policy makers, think tanks, civil society and industry and aids in designing and implementation of energy efficient and cleaner transport policies.

• Emission Standards

On- Road vehicles are a key contributor to air pollution in the country. Pollutants like Carbon Monoxide (CO), Hydrocarbons (HC), Oxides of Nitrogen (NOX) and Particulate Matter (PM) emitted by vehicles not only increase the local air pollution but also significantly impact the health of the people. In order to reduce the vehicular air pollution, emission standards were instituted in India by the Government of India.

The first set of mass emission limits were implemented in 1991 for petrol vehicles and in 1992 for diesel vehicles, which were gradually made stringent during 1990s. In the year 2000, India 2000 norms were implemented for passenger cars and commercial vehicles which were equivalent to Euro I norms (DieselNet). In 2001, Bharat Stage II (Equivalent to Euro II) norms were implemented for all the vehicles in cities of Delhi, Mumbai, Chennai and Kolkata (SIAM). The National Auto Fuel Policy (2003) laid out the roadmap for nationwide implementation of Bharat Stage II (BS II) norms by 2005 and of BS III (equivalent to Euro III) along with implementation of BS IV norms in 13 cities by 2010 (PIB, 2015). In 2015, the draft Auto Fuel Policy and Vision 2025 recommended the roadmap for implementation of BS IV norms across the country in a phased manner and it further envisaged

advancing the introduction of BS VI norms by 2020 by leapfrogging the BS V norms (SIAM). The implementation of BS IV was a major step towards addressing the issue of extremely high levels of pollution across Indian cities. The implementation reduced the limit on sulphur content in petrol and diesel to 50 ppm from 150 and 350 ppm respectively. With the implementation of BS VI norms by 2020, it is expected to further reduce sulphur content up to 10 ppm for both diesel and petrol vehicles (TransportPolicy.net).

Emission from vehicles is majorly determined by factors like vehicular technology, fuel quality, inspection & maintenance of in-use vehicles and road & traffic management. In order to control and regulate these factors a multi-agency approach is necessary. While the task of setting up the emission standards is carried out by the Ministry of Road Transport and Highways (MoRTH) in India; the enforcement happens through industrial stakeholders like Society of Indian Automobile Manufacturers (SIAM), the apex industry body in the country which represents the leading vehicle and vehicular engine manufacturers in India and several industrial research associations.

• MOVE TOWARDS ALTERNATIVE FUELS : BIOFUEL POLICY • As India is going through demographic dividend its energy demand is also increasing. The existence of strong correlation between energy consumption and economic growth is highly reinforced by the critical role that energy plays in the socio-economic development of the country. Given the fact that a significant share of India's energy demand is met by fossil fuels which are highly polluting and non-renewable it is important to give impetus to renewable resources which are indigenous, non-polluting and inexhaustible (National Policy on Biofuels, 2018).

Due to India's high dependency on fossil fuel based energy sources, energy security is also a key area of concern. Road transport sector which contributes 6.7% to India's total GDP accounts for the highest share of this energy consumption. The limited domestic production of crude oil in India has led to a rising import dependency with India currently importing 82% of the crude oil (National Policy on Biofuels, 2018). In order to address these concerns Government of India announced the National Biofuel Policy in 2009 and was further amended in 2017 to increase the targets and has been named as National Policy on Biofuels-2018.

The policy aims to increase the penetration of biofuels (derived from renewable biomass resources) in the energy and transportation sector of the country. As the production of biofuel will mainly rely on domestic feedstock, this substitution for fossil fuels will subsequently promote energy security, climate change mitigation and will create additional employment opportunities for farmers and cultivators in a sustainable manner. **At present, ethanol blending in petrol is around 2% and biodiesel blending in diesel is less than 0.1%.** The policy proposes to achieve the target of 20% ethanol blending in petrol and 5% biodiesel blending in diesel by 2030. As the major thrust area of this policy is to ensure generation of biofuels from indigenous feedstock, Government plans to create a National Biomass Repository by conducting assessment of biomass and feedstock samples across the country. (National Policy on Biofuels, 2018)

Effective implementation of the biofuel programme is largely dependent upon active participation from the central and state governments, farmers, industry and professionals. **With an assured policy support from the central government, several public and private sector industries are generating biofuels. Pune based Praj Industries Limited has developed technology to produce ethanol by utilising agri-waste like sugarcane trash, rice and wheat straw, etc. The process is based on techno-socio-commercial model as farmers are getting better prices for their produce and the agri-waste which was traditionally burnt for household cooking is being utilised sustainably.**
In Assam, a joint venture between Numaligarh Refinery Limited, a public sector enterprise and Chempolis Oy, a Finnish technology firm plans to produce 60 million litres of ethanol every year by using bamboo. In addition to this, several of the Indian oil companies are investing in biofuel refineries to increase the production of ethanol from non-molasses sources and to promote the green-fuel use.

Cultivator's and Farmer's Perception of Biodiesel

Sugarcane molasses is the main source for ethanol production and oil from jatropha & other oilseeds is used for biodiesel production. It has been observed that promotion of biofuels is dependent on various factors among which feedstock supply and management is the key issue at local level. To understand the feasibility scenario of Jatropha cultivation, Integrated Research and Action for Development (IRADe) and IT Power India Pvt Ltd undertook an analysis based on surveys conducted in 41 villages of Rajasthan and Orissa.

In Rajasthan, enthusiastic participation was observed from farmers for Jatropha cultivation. The State has initiated several programmes for supporting the plantation. Additionally, many private sector companies are also promoting farming through contracting farmers.

In Orissa, farmers have taken up cultivation of Jatropha on their waste lands without compromising on the growth of the plantations. Several Self Help Groups (SHGs) have also been established in the process. It was observed that in both the states the additional economic benefits from the use of waste land have been the driving force for the cultivation. Please give reference to the below table somewhere in the text.

	Analysis of Survey Data : Farmer's Perception for Choosing to Plant Jatropha	
Reasons for Planting Jatropha	Rajasthan	Orissa
Economic Benefit	92%	96%
Best Use of Wasteland	54%	77%
Low Inputs Requirement	77%	-
Support from local organisations	-	32%
Protection from cattle not required	46%	-

Source : (IRADe, IT Power India Pvt Ltd., 2011)

TEXT BOX 3

CONCLUSION

To counter the trend of increasing fuel consumption and rising emissions along with meeting the national commitments, a set of policy measures is being implemented by the Indian government in the transport sector. However, in order to ensure that these policy measures are effective in decarbonizing the road transport sector, it is important to build a holistic approach for confirming strong implementation and compliance of various policy goals. To this end, a multi-stakeholder approach which includes contribution and actions from civil society, corporates, think tanks and other public and private actors through decentralised action can play a crucial role in bringing down emissions from road transport sector.

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