Decarbonising the Future Transport in the Electrical Way: An Indian Perspective

K.T. Logabiram*

Department of Electrical and Electronics Engineering,
Bhaktavatsalam Polytechnic College, Kanchipuram, Tamil Nadu – 631 552, India.
*Corresponding author Email: ktlogabiram@gmail.com

Abstract

Man-made climate changes are the major factors, contributing to the extreme weather events. If not mitigated, the events will lead to disaster and render the planet earth, unliveable for the future generations. Transport sector is responsible for roughly one quarter of emissions from the burning of fossil fuels. According to the latest Transport outlook (Organisation for Economic Co-operation and Development/International Transport Forum, 2017a) CO_2 emissions could increase by 60 % by the year 2050, road traffic being the main contributor in global warming, leading to draughts, sea level rise, threatening low-lying regions, severe disruptions due to extreme weather [9]. Bio-fuels and Electrification of the transport are the possibilities to address this concern. In Electrification, again the mode of energy generation should not contribute to environmental hazards. With the renewable energy sources, clean energy can be ensured. In this paper, the current scenario in India and the scope for carbon neutral mobility are discussed.

Keywords: Decarbonisation, Renewable energy, Green House gases, Mobility transition, Electric Vehicles.

1.Introduction

The UN Climate Change Conference in Paris during 2015 resolved to keep the global temperature rise well below Two Degrees Celsius. Most of the emissions are produced by G20 countries and the emission levels continue to be on the rise [1]. To fulfil the 2° C stabilization target, the total national electric supply must be decarbonised, which will take another two decades. Policies should shift to Electric Vehicles (EVs), which can deliver sizable pollution objectives [2].

Indian Railways (IR) is currently the second largest railway network in the world and the single largest consumer of electricity in India. Its consumption is 2 % of the nation's total power generation. Apart from that, IR consumes 2.6 billion litres of diesel in a year. The complete decarbonisation of IR, will bring savings to itself apart from meeting the national emission reduction and renewable power targets [3].

Currently deployed policies towards mitigation of carbon emission offer little confidence considering the present scenarios. They necessitate radical transformation of transport system resulting in key policy challenge. Energy transition is the driver to the transport transition. Behaviour of the user and the living style also play a vital role in Decarbonisation [4].

Implementation of the currently available market ready low-carbon transport measures can be adopted in the short term. Then, medium to long term commitments are established in the transport sector, in order to fully mitigate the carbonisation [5]. Any single method will not ensure the use of EVs, whereas multiple measures be implemented to motivate individuals for higher uptake in EVs [6].

The Electric mobility in India needs to be addressed from Auto Industry perspective, Consumer perspective, Policy, Infrastructure and Training [7]. For developing countries, policies that favour Decarbonisation without compromising the socio-economic growth and benefits need to be framed [8].

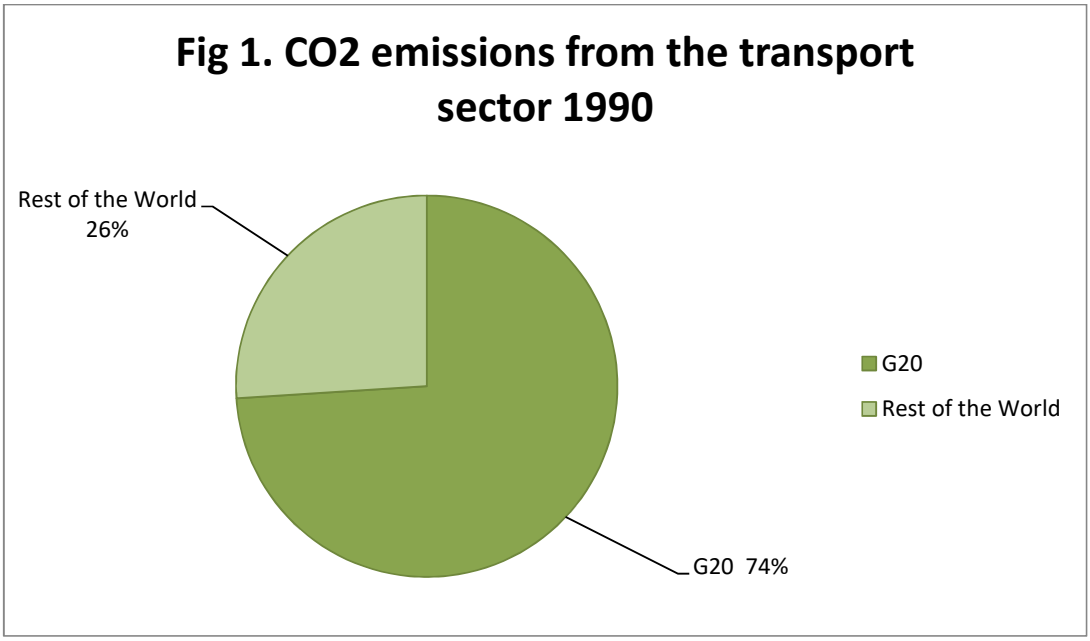
2. Assessment on Carbonisation

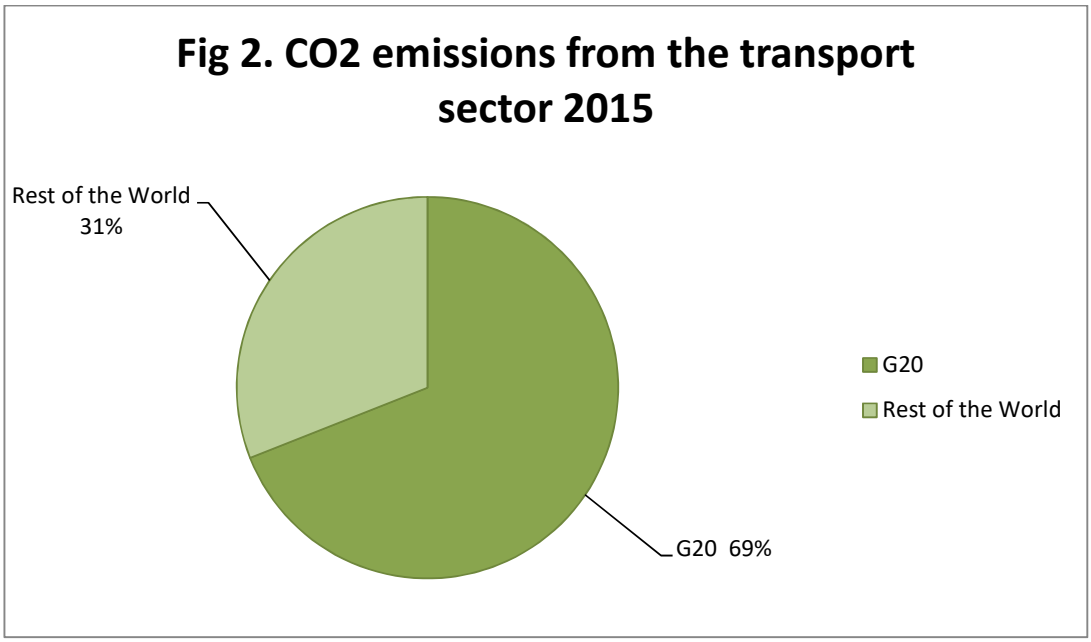
About two-thirds of the world population is accounted for in G20 countries. But 80 % of present global Green House Gases (GHG) emission are from these countries. In this, transport sector emits around 23 % of the energy related CO_2. In the absence of immediate action, its share could reach 40 % by the year 2030.

It is observed that transport emissions are growing faster, compared to other sector emissions, over the past 50 years. The developing countries have to bear the brunt of these resolutions/policies which impose stringent limitations on their growth, especially transport and industry sectors. Imposed global norms have to be complied with, before they explore the avenues for their economical growth in the related sectors.

Demand for transportation and related infrastructure will continue to grow on a vast scale in the coming decades. Bringing down the CO_2 emissions in this sector will be a mammoth task. As the transport depends on oil for 92 % of the energy, it is hard to decarbonise. To comply with the Paris Agreement to keep the global warming well below 2° C, the G20 are the pilot countries, to achieve this Sustainable Development Goals (SDGs). They bear the greatest responsibility for the global transport, its impact on air quality, climate change and energy consumption.

The CO_2 emission from the transport sector during the year 1990 and in 2015 are shown in Fig. 1 and Fig. 2, respectively.





Transport sector's demand is 30 % of the total energy generated. Out of this, approximately 3 % of the energy is supplied from renewable energy sources, mainly from Bio-fuels. To decarbonise transport, renewable energy should accelerate its contribution towards transport. Both transport sector and renewable energy sector should integrate to mitigate the environmental impacts.

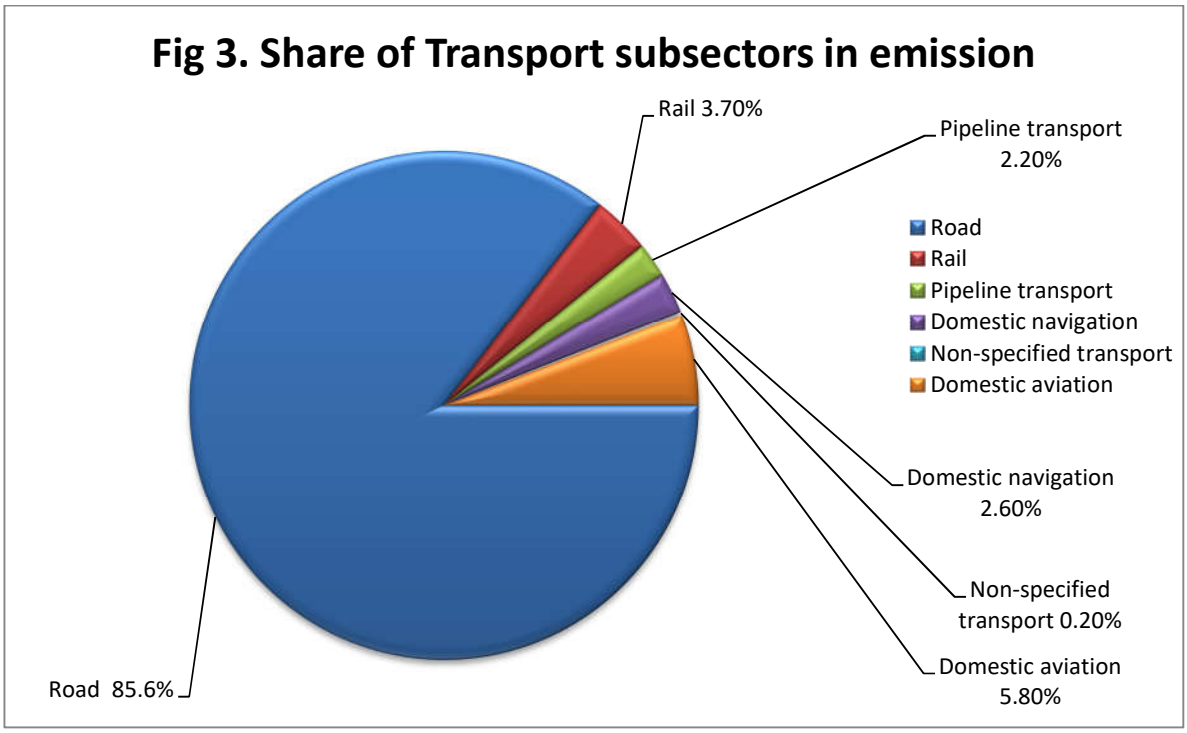
3. Transportation – Implications on Society and Economy

Transportation is crucial for freight and people in today's society and global economy. It enables to choose the place to work, live and spend time. It facilitates personal freedom. In addition, transportation plays a vital role in the country's economy, enabling movement of goods across the nations and development of production chains across the world. Contributors to the increase in transportation volumes are trade and economic growth, population explosion and increase in income level.

However, it is not without an associated cost. The costs associated with these benefits are rise in road fatalities, millions of pre-mature deaths annually due to vehicular air pollution. For instance, 1.25 million people died in accidents around the world in 2013, whereas 50 million people suffered non-fatal injuries. 75 % of the 3 million premature deaths were due to air-pollution that occurred in G20 countries.

Hence, the transport policy to be chosen, faces the challenge of accommodating these partially conflicting demands. Basically, the policy should enable mobility as it is important for economic development of a country and fulfil/enhance the individual mobility needs. On the other hand, it should scale down the detrimental effects on the environment, public health, climate and safety.

Transport sector contributes to 17 % of total emission. The share of transport sub-sectors in emission in the G20, 2015 is given in Fig. 3.



4. Approach towards Decarbonisation

Decarbonisation demands the transition in the transport sector. Transition of the transportation is twofold. One is the Mobility Transition and the other is the Energy Transition.

4.1 Mobility Transition:

The increase in the overall efficiency of the transportation without limiting mobility is the idea of mobility transition. Efficient means of transport are the key aspects to the people movement as well as goods transport. Reducing travel time viz. Optimizing the traffic route, employing modern communication and technology, urban planning solution, rendering travel unnecessary. Though the mobility transition is vital and provide scope for cut down on CO_2 emission it is rather circuitous, roundabout method and limiting on the personal choice.

4.2 Energy Transition

The key to energy transition is to employ the carbon-neutral energy. This transition has flexibility on its choices. The energy could be from either Bio-Fuels or Electricity. Improving the energy efficiency viz. Reducing final energy requirements, Fuel economy and CO_2 emission standards, zero or near-zero carbon fuels are the factors when using bio-fuels i.e., Bio-diesel, CNG/LNG. When employing electrical energy for the transport sector, it should be sourced from renewable and clean energy sources. Fig. 4 shows the energy transition in the transport.

4.3 Need for electrification

To decarbonise the transport sector, be it road or rail, it is necessary to reduce the use of Fossil fuels, to the maximum possible extent. Bio-diesel market is at a very early stage, faced with

supply constraints and shortages. CNG/LNG fuels are still in the demonstration stage and in the near future they are unlikely to become commercially available. So the ideal and more practicable methodology is electrifying the transport sector. Once electrified, transition to clean energy sources viz. Solar, Wind, small Hydro can smoothly take place. Solar and Wind energy are the main renewable sources which can be relied on, for the magnitude of the sector's power requirement. It is a pre-requisite to deploy Electric Vehicles for roads and to electrify the railway networks. Most efficiently, direct use of electricity in Battery Electric Vehicle (BEVs) and Plug in Hybrid Electric Vehicle (PHEVs) has seen a rapid growth recently. Fuel Cell Electric Vehicles (FCEVs) uses renewable electricity based hydrogen.

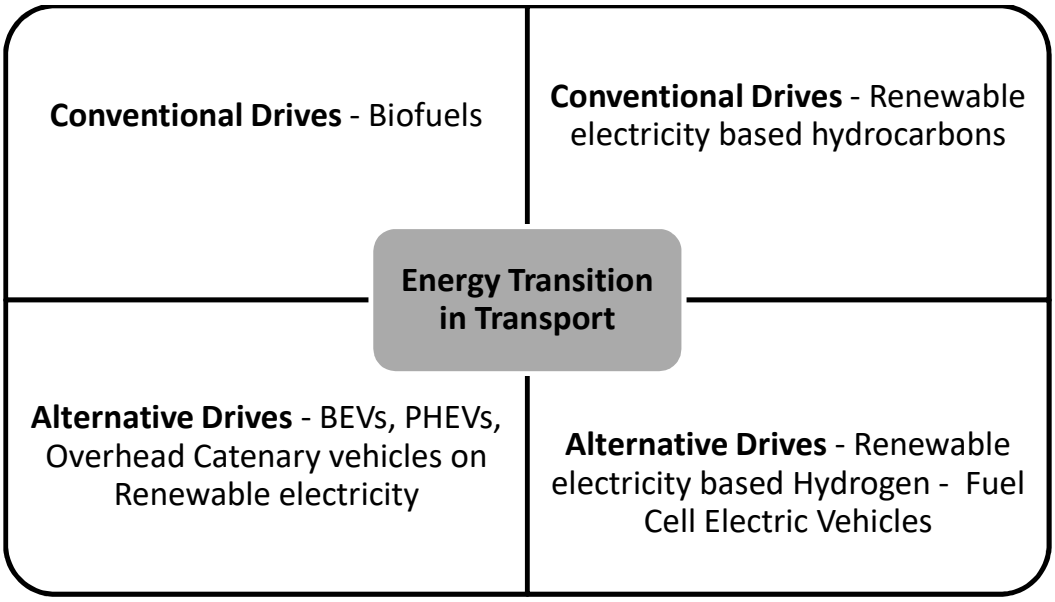


Fig 4. Energy Transition in Transport

5. India – Facts, Figures and Commitment to CO_2 reduction

India has a total area of 3,287,259 Km^2 with 450.42 people/Km^2. Its share of Global area is 2.4 %. It is a densely populated country with 1339.2 million people and the share in global arena is 17.74 %.

The urban population is 33.6 % of total population. The motorisation rate is 17 road motor vehicles for 1000 people.

The volume of passenger transport is 18,099,835 million passenger-km and the Goods/Freight transport volume is 3,238,569 million tonnes-km.

With 1.5 t CO_2 for total emission and 0.19 t CO_2 for the transport sector, **India's per capita emissions are the least in G20 countries**. Yet, the emission from the transport sector could quadruple up to 2030. Major contributor in the emission is Road transport. Road transport accounted for 88.6 % of emission in 2015, whereas Railway's share was only 8 %. The emission cut-down methodology should orient itself towards road transport. The focus of research should be on road transport improvement.

As on 2016, India has 6800 Battery Electric Vehicles. It is committed to reduce the emission-intensity of GDP by 33-35 % in 2030 when compared with 2005. Also in the pipeline is increasing the share of rail transport in total transportation from 36 % to 45 %.

In the Electric Vehicles category, by 2030, India targets to deploy 30 % electric cars and 100 % BEVs for urban buses. There are certain barriers to the massive deployment of Electric Vehicles on the Indian Roads. They are summarised in Fig. 5

5.1 Barriers to Electric Vehicles

The share of EVs on the Indian transportation especially on roads is very minimal, till now. Though it receives the attention of all the stake holders, there are certain factors which act as barriers to them, which scale down the penetration of the EVs in Indian transport sectors. The barriers are classified under four heads viz. Technology, market related, infrastructure needs and policy initiatives.

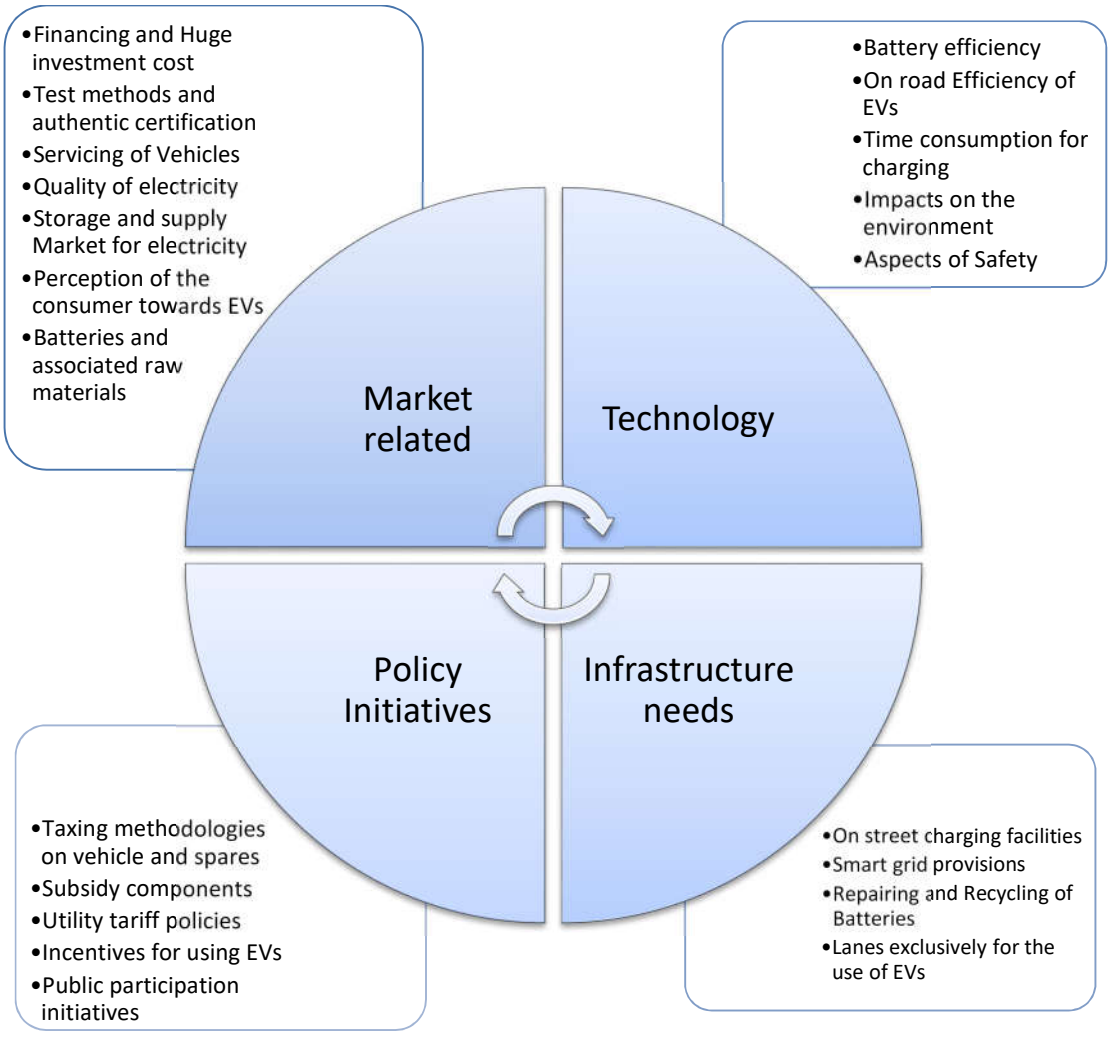


Fig 5. Barriers to Electric Vehicles

The technical barriers include battery efficiency, charging time and the driving range. The conventional lead acid battery becomes bulky for increased driving ranges. This is due to the fact that the specific energy density is very low in lead acid batteries. So, for long driving ranges they add to the overall weight of the EVs. Lithium ion and Lithium sulphur batteries can provide higher specific energy densities. With improvement in technologies, low charging time and higher driving ranges can be realised.

Market and infrastructural barriers are characterised by Charging facilities akin to petrol pumps, repair and recycle of batteries, exclusive lanes for EVs, Servicing of vehicles, availability of materials, perception of the consumers towards EVs.

The policy barriers are various components like taxing methodologies, subsidy components, tariff policies, incentives, public participation etc.

5.2 Policies/Methodology for Implementation

The implementation of decarbonisation of transport in India is considered under two modes of transitions viz. Mobility and Energy transition. Table 1 and Table 2 depict the policy initiatives and the associated process under each mode, respectively.

POLICY	PROCESS
1. National Level programmes to encourage and support shifting to public transport mode	Expansion of Metro Rail systems Smart Cities Mission Atal Mission for Rejuvenation and Urban transformation Urban Green Mobility Scheme (approval awaited)
2. Supporting measures for Low-Carbon freight logistics	Dedicated Freight Corridors (FDCs) for rail freight and goods Supporting Coastal Shipping and Inland Water Transport Development Multi-modal Logistics Parks (MLPs)
3. Measures at National level to support non-motorised transport	National Bicycle Sharing Scheme
4. National level measures supporting new mobility initiatives	Regulatory measures in the transport bill to be passed during 2018
5. Road Charges	No general charges except National Highway tolls.

Table 1. Mobility Transition

POLICY	PROCESS
1.Standards on energy/carbon emission for Light Duty vehicles	Target for the year 2022 for CO_2 : 113 g/km
2. Standards on energy/carbon emission for Heavy Duty vehicles	From April 1, 2018 fuel efficiency standard for HDVs > 12t From 2021 onwards, an average increase of 10.4 % in efficiency
3. Instruments for pricing	No taxes based on energy consumption or CO_2
4. Mandatory Labelling of vehicles	BEE Fuel Savings Guide label
5. Mechanism to support EVs and Charging infrastructure	Extension of the FAME scheme (Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India
6. Supporting Other low-carbon fuels and propulsion systems	Hydrogen Corpus Fund National Bio-diesel mission National policy on Bio fuels Bio-diesel Purchase policy Price control of ethanol and bio-diesel Indian Railways Organization for Alternate Fuels (IROAF)
7. Mandatory targets for Biofuels	A share of 22.5 % is mandated for Bioethanol (up from 10 %) and 15 % for Bio-diesel.

Table 2. Energy Transition

6. Conclusion

It is encouraging that the progress towards decarbonisation is gaining momentum, globally. Resolutions/Policies by many nations either suo moto or as a forum takes place. For the developed nations, cutting down on the carbon emission seems to be the prime task. Whereas, the developing countries should ensure both, growth in economy as well as green in environment, together. Conflicting interests have to go together.

Far more ambition is needed, else the process of decarbonisation will become more painful. Enacting the fuel standardisation and electrification alone will not suffice. With growing population, Public mobility and Freight movement are huge. Measures need to be put in place to shift to efficient, less carbon intensive mode of transport. Attitudinal changes are needed to utilize public transport instead of private/personal transport. Optimization of routes, alternatives to physical travel (for example –ICT modes, video conferencing) are the need of the hour. The pride/trend of possessing larger vehicles (SUVs) should be curbed and smaller, lighter vehicles should used.

The energy from renewable sources can drastically bring down the emission of carbon. Greater reliance on Solar and Wind power generation should be achieved, with new/practicable technology. Subsidies on Fossil fuel to be eliminated and incentives for Bio fuels and CNG/LNG be given. A comprehensive approach should be put in place to achieve Carbon Negative in order to attain Carbon Neutrality at a faster pace, in the immediate future.

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