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Role of Public Policy in India's Transport Sector Towards Energy Transition: A Critical Analysis

Monica Pradyot[1] & Saksham Pradyot[2]

Abstract

The global energy landscape is undergoing a critical transformation, driven by concerns around climate change, energy security, and resource depletion. This transition necessitates a shift from traditional fossil fuels towards cleaner and more sustainable energy sources. As per the IPCC Special Report of 2018, governments must achieve 1.5 degrees Celsius by 2030 to limit global warming. Therefore, public policy plays a vital role in driving this transition by creating incentives and regulations that promote low-emission vehicles (LEVs), develop infrastructure for LEVs, encourage public transportation use, and influence urban planning for sustainability. However, several significant challenges, such as financial, institutional, social and technological barriers, can impede the implementation of these policies. Despite these challenges, public policy remains the cornerstone of the global effort to achieve a sustainable and energy-resilient future. The paper will discuss the multifaceted role of public policy in impacting sustainability and climate change mitigation. The study's primary objective is to examine how various policy instruments, such as subsidies, regulations, and incentives, influence the adoption of renewable energy technologies and the reduction of greenhouse gas emissions. The authors seek to analyse various public policy instruments adopted by other countries and will provide a pragmatic suggestion to develop a robust roadmap for a sustainable environment.

Keywords: Climate change, Energy Transition, Sustainable Future, Public Policy.

Introduction

The conventional source of energy such as oil, coal and natural gas collectively referred to as "black" energy is heavily consumed by the transport sector. These energy sources have fuelled the rapid expansion of the transport industry over the last century, with oil derivatives like gasoline and diesel being the dominant fuels for vehicles. In case of road transport, cars, buses, and trucks primarily rely on gasoline and diesel. In 2022, International Energy Agency (IEA) estimates that around 90% of the world's transport energy consumption comes from oil-based fuels[3]. The transport sector's dependence on fossil fuels has also led to negative impact on environment, primarily due to the combustion of these fuels releasing large amounts of greenhouse gases (GHGs) and other pollutants. Transport sector is the second largest sources of carbon dioxide (CO_2) emissions and produced approximately 8.4 billion metric tons of CO_2 in 2023[4], which accounted for about 21.1% of global GHGs (figure 1). This makes the sector a key contributor to global climate change. The CO_2 emitted from burning fossil fuels contributes to the greenhouse effect, which traps heat in the Earth's atmosphere and raises global temperatures. This leads to more extreme weather, melting glaciers, and rising sea levels.

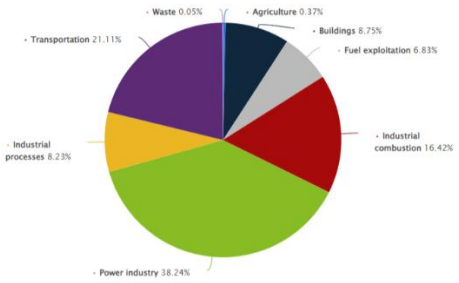

Figure 1: Distribution of carbon dioxide emissions worldwide in 2023, by sector (Statista 2024)

[1] Monica Pradyot, Assistant Professor (Senior Scale), School of Law, UPES Dehradun.
[2] Saksham Pradyot, Assistant Professor (Senior Scale), School of Law, UPES Dehradun.
[3] International Energy Agency. (2022). *Global energy consumption in transport by fuel: World 2022.*
[4] Statista. (2024). *Distribution of carbon dioxide emissions worldwide in 2023, by sector.*

Besides CO_2, fossil fuel combustion in vehicles emits other harmful pollutants, such as nitrogen oxides (NOx), sulphur dioxide (SO_2), and particulate matter (PM). These pollutants can cause severe health issues, including respiratory problems, cardiovascular diseases, and premature death. The extraction, transportation, and refining of oil have their own environmental consequences. Oil spills from tankers and drilling operations cause devastating damage to marine ecosystems. Furthermore, deforestation, habitat devastation, and soil degradation are frequently caused by the discovery and extraction of fossil fuels. The sector's long-term dependence on fossil fuels is unsustainable due to their limited supply. There is increasing economic pressure to develop alternate energy sources as reserves diminish, particularly in areas like India where domestic oil production is very low.

Today India is the 5th fastest growing economy in the world with US $3.9 trillion GDP[5] and has 1.44 billion population[6] in 2024, leading to large production and consumption of vehicles majorly run by carbon intensive fossil fuel. Being the 3rd largest contributor to global carbon emission (CO2)[7], need of public policy towards green energy has become vital for India. In pursuance of which, India adopted Paris Agreement in 2015[8] with an aim to maintain a global temperature not more than 2 degrees Celsius. In November 2021, India committed to achieve net zero emission by 2070[9] at Conference of Parties (COP21). This has led to the development of various policy measures aimed at reducing the CO2 emissions, such as fuel efficiency standards, electric vehicle incentives, and the development of public transportation systems. The government of India is promoting Electric Vehicles (EVs), and other alternatives fuels such as biofuels, hydrogen, and natural gas. It has taken Initiatives like the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme[10] in 2015, National Electric Mobility Mission Plan (NEMMP)[11] in 2020, and policies favouring EV infrastructure development. India seeks to have 30% of vehicles powered by electricity, reducing reliance on petroleum imports and lowering emissions by 2030. Therefore, the decarbonization of the energy mix to achieve net zero emissions to mitigate climate change is the purpose for energy transition.

This paper aims to understand how public interventions can facilitate the shift from fossil fuel dependency to sustainable and renewable energy sources. This analysis focuses on evaluating the strategies, incentives, and regulations that governments implement to reduce greenhouse gas emissions and promote clean energy technologies, such as electric vehicles, hydrogen fuel cells, and biofuels.

The paper will also examine the effectiveness of these policies by assess their success in achieving two Sustainable Development Goals (SDGs)[12], particularly SDG 7 i.e., Ensuring access to affordable, reliable, sustainable, and modern energy for all by promoting clean energy in transportation systems and SDG 13 i.e., Taking urgent action to combat climate change by reducing transport-related carbon emissions and improving air quality.

The paper also seeks to identify policy challenges, and potential reforms needed to enhance the adoption of green technologies and accelerate progress toward achieving these SDGs, thereby contributing to a more sustainable and clean future.

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[5] International Monetary Fund. (2024). *World economic outlook.*
[6] Worldometer. (2024). *India population (2024).*
[7] Bhattacharya, S. (2022, November 11). Report at COP27: India records highest emission increase among top global contributors. Outlook India. Friedrich, J. (2023). This interactive chart shows changes in the world's top 10 emitters. World Resources Institute.
[8] United Nations. (2015, December 12th). The Paris Agreement | United Nations.
[9] Ministry of Environment, Forest and Climate Change. (2023). *Net zero emissions target.*
[10] Ministry of Heavy Industries, Government of India. (2023, July 25). *FAME India Scheme.*
[11] Department of Heavy Industry, Bureau of Energy Efficiency, Ministry of Power, Government of India. (n.d.). *National Electric Mobility Mission Plan.*
[12] THE 17 GOALS | Sustainable Development. (n.d.).

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- **Policy Landscape for Energy Transition in Transport Sector of India**

India is 3rd largest oil importing and consuming country in the world[13]. According to Petroleum Planning and Analysis Cell, import dependence on crude oil soared to 87.7% in 2023-24[14]. India imported 232.5 million tonnes of crude oil, which is refined into fuels like petrol and diesel. The import bill for 2023-24 was USD 132.4 billion (Figure 1). However, the imported oil is used by various sectors in India such as transportation, power, agriculture, manufacturing, fertilizers, etc. According to the Ministry of Petroleum and Natural Gas (MoPNG), the transport sector accounts for nearly 40% of total oil consumption in the country. The primary fuel for heavy-duty vehicles like trucks and buses, accounts for around 70% of energy use in road transport. The passenger cars and two-wheelers run by petrol, contributes around 20-25% of energy consumption. Compressed Natural Gas (CNG), particularly used in buses and taxis, constitutes a small percentage but is growing, especially in urban areas. Although electricity powered vehicles are negligible at present, it is expected to play a larger role in the coming years with policy pushes for EV adoption.

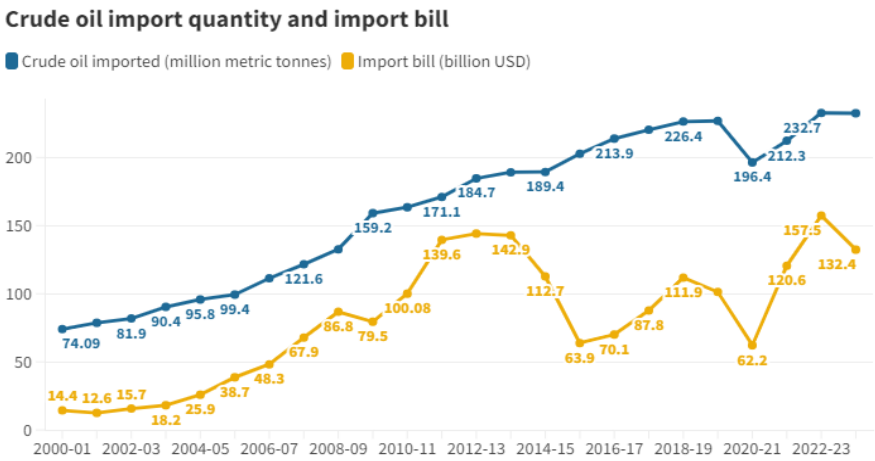

Figure 2: Petroleum Planning and Analysis Cell, Ready Reckoner reports

India's heavy reliance on fossil fuels is not only contributing significantly to environmental pollution but also making it highly vulnerable to fluctuations in global oil prices, as a substantial portion of its GDP is spent on importation of crude oil. It also raises concerns about energy security, especially during geopolitical crises or global supply chain disruption like in case Ukraine-Russia war in 2023. Adding to such problem, India also aims to have net zero emission target by 2070, considering the fact that transport sector is one of the biggest sources of carbon emission. However, to meet the twin objective, India is witnessing a significant shift toward cleaner and more sustainable energy options driven by various public policies and regulatory frameworks. It has introduced emissions standards, fuel efficiency norms, and vehicle scrappage policies to phase out older, polluting vehicles.

1. **National Electric Mobility Mission Plan (NEMMP)[15]:**

It was launched in 2013 and is a key policy initiative to promote hybrid and electric vehicles (EVs) in India. Its goal is to create a cleaner and more fuel-efficient transportation sector by shifting toward electric mobility. It also offers subsidies for hybrid and electric vehicle production to incentivize local manufacturing.

[13] Standing Committee on Petroleum & Natural Gas. (2023). *Review of policy on import of crude oil (Twenty-third report, 2023-24, Seventeenth Lok Sabha).* Ministry of Petroleum & Natural Gas, Government of India.
[14] India's crude oil import bill drops 16% but import dependency hits new high. (2024, April 19). *Economic Times*.
[15] Ministry of Heavy Industries, Government of India. (2023, July 25). *FAME India Scheme.*

2. **Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) Scheme[16]:**

As a direct outcome of NEMMP, the FAME scheme was introduced in 2015 to provide incentives for the purchase of electric vehicles and establish EV infrastructure, such as charging stations.

i. **FAME I (2015-2019):** The initial phase focused on demand creation by offering subsidies for two-wheelers, three-wheelers, and four-wheelers, as well as buses. Rs. 895 crore ($110 million) was allocated to support EV buyers.
ii. **FAME II (2019-present)**: Budget of Rs. 10,000 crore ($1.3 billion), extended to 2024, focusing on larger EV adoption in public and commercial transport. It emphasizes on infrastructure development, especially charging stations (targeting 2,700 charging stations across India).

3. **Renewable Energy Policies and Targets for the Transport Sector:**

i. **National Policy on Biofuels**: The government has emphasized biofuels as an alternative fuel source for the transport sector. The National Biofuel Policy 2018[17] targets a 20% ethanol blending in petrol and a 5% biodiesel blending in diesel by 2030. This policy seeks to promote the use of biofuels derived from agriculture, municipal waste, and other sources to reduce reliance on fossil fuels.

ii. **Green Hydrogen Initiative**: Under the National Green Hydrogen Mission[18], India aims to integrate green hydrogen into transportation, especially in sectors such as long-haul trucking and public transport. Hydrogen fuel cell technology is being explored as a long-term solution for decarbonizing transport, with pilot projects for hydrogen-powered buses in cities like Delhi and Mumbai.

iii. **Renewable Energy Targets**: India has set a target of 175 GW of renewable energy capacity by 2022, which includes a focus on increasing the share of renewables in the transport energy mix. It focuses on solar-powered charging infrastructure for electric vehicles[19]. The government also aims for 30% electric mobility by 2030, with a large portion of vehicles relying on renewable energy.

4. **Carbon Tax Policies:**

India has not yet implemented an explicit carbon tax, but certain policy measures indirectly tax carbon emissions. The government levies a Rs. 400 per ton coal cess, which acts as a form of carbon tax, with the funds going to the National Clean Energy Fund (NCEF) to finance renewable energy projects. In some states, like Delhi, an additional pollution cess is levied on diesel vehicles to discourage the use of high-emission vehicles. While there is no direct carbon tax on the transport sector, discussions are ongoing to implement a broader carbon pricing mechanism to push industries and consumers toward cleaner alternatives.

- **Challenges in implementing Public Policy for Energy Transition in India's Transport Sector**

While renewable energy solutions such as electric vehicles (EVs), biofuels, and hydrogen are being adopted, they still represent a small fraction of the total energy mix in transport. The overwhelming dominance of fossil fuels, which supply over 90% of the sector's energy, hampers the pace of transition to low-carbon alternatives. This limits the potential for

[16] Ministry of Environment, Forest and Climate Change. (2023). *Net zero emissions target.*
[17] Press Information Bureau. (2018). *Cabinet approves National Policy on Biofuels - 2018.* Ministry of Information and Broadcasting, Government of India. Press Information Bureau. (2023). *India has achieved the target of 10 percent ethanol blending, 5 months ahead of schedule.* Ministry of Information and Broadcasting, Government of India.
[18] Government of India, Ministry of New and Renewable Energy. (2023, January). *National Green Hydrogen Mission.* Government of India, Ministry of New and Renewable Energy. (2023, January). *National Green Hydrogen Mission.*
[19] United Nations. (2022). *India plans to produce 175 GW of renewable energy by 2022.* Sustainable Development Goals.

widespread adoption of cleaner transport technologies. This led to the need of strong and promising public policy in this regard.

Although India has a comprehensive public policy framework, India faces several challenges in fully implementing the energy transition in the transport sector. These challenges are primarily related to infrastructure barriers, technological barriers, financial constraints, and gaps in policy formulation and execution.

i. **Infrastructural barriers**: The infrastructure for alternative fuels, such as EV charging stations and hydrogen refuelling stations, remains underdeveloped. While policies like FAME II aim to install thousands of charging stations, the current network is far from sufficient, especially in rural and semi-urban areas. The slow pace of development limits consumer confidence in adopting EVs, as range anxiety persists. Charging infrastructure is primarily concentrated in metropolitan areas, with minimal penetration in smaller cities and rural regions, which discourages EV adoption beyond large urban centres.
To charge EVs, more than 70% of the power is generated from coal, which also contributes to the CO2 emissions, thus negating the environmental benefits of adopting an EV. While solar-powered charging stations are being promoted, they remain few in number.

ii. **Technological barriers:** Technologies related to biofuels, hydrogen fuel cells, and natural gas vehicles are still emerging. There is limited domestic capacity to produce biofuels at scale, and hydrogen infrastructure is practically non-existent in India. A large portion of EV components, particularly lithium-ion batteries, are imported, primarily from China. This dependence increases costs and delays technological advancements.

iii. **Financial barriers:** The cost of electric vehicles and other energy-efficient technologies remains prohibitively high for a large segment of the population. Despite subsidies provided under schemes like FAME, EVs are still significantly more expensive than conventional petrol and diesel vehicles. The high upfront costs deter many consumers from adopting these technologies. While there are financial incentives for electric vehicles, fewer incentives exist for adopting alternative clean fuels like biofuels or hydrogen. This lack of financial support limits the development and deployment of a broader range of low-emission transport options.

iv. **Policy barriers:** There is an inconsistent implementation of policies across states and regions. While metro cities have seen progress in EV adoption and infrastructure development, other states lag behind due to varying levels of policy enforcement, political will, and resource allocation. Despite policies promoting ethanol blending and green hydrogen, the infrastructure and financial support for scaling up these technologies are inadequate.

v. **Consumer preference barriers:** While looking at the Consumer preferences, for larger, fuel-intensive vehicles, such as SUVs, it continue to drive up oil demand and emissions. In many regions, public transport systems are underdeveloped or poorly maintained, leading to increased reliance on personal vehicles.

- **Public Policy: A Global Perspective**

The transport sector remains heavily reliant on fossil fuels, which account for most of the energy consumption in this sector globally. Despite growing awareness of climate change and the push towards renewable energy, fossil fuels such as oil, diesel, and gasoline continue to dominate the energy mix in transportation. Considering the global challenges, United Nation adopted SDG 7 and SDG 13 which is inextricably linked with each other. It is, therefore, imperative to say that to meet the twin object i.e., energy efficiency as well as combat climate change, a reform though public policy is what countries needed.

Public policy plays a pivotal role in steering the transport sector from its dependence on fossil fuels to adopting sustainable and green energy solutions. Governments worldwide have introduced a variety of policies aimed at reducing greenhouse gas emissions, promoting renewable energy use, and encouraging the transition to low-emission transport systems.

1. **Regulatory Policies:**

   i. **Fuel Efficiency Standards**: Governments worldwide have set fuel economy or CO_2 emissions standards to ensure that vehicle manufacturers produce more fuel-efficient cars, trucks, and buses. These standards encourage innovation and the development of low-emission technologies such as electric and hybrid vehicles. E.g., in US, the Corporate Average Fuel Economy (CAFE) standards[20] require automakers to improve the average fuel efficiency of their fleets over time.

   ii. **Emission Reduction Targets**: Countries adopted the Paris Agreement 2015, which require them to set a specific GHG emission reduction targets. Policies such as carbon pricing, emissions caps, and vehicle emission standards are being implemented to meet these targets. Like, European Union's CO_2 emission performance standards for new cars and vans aim to reduce emissions by setting stringent limits on CO_2 output per kilometre[21].

   iii. **Bans on Internal Combustion Engine (ICE) Vehicles**: To accelerate the transition to electric and zero-emission vehicles, a number of nations have declared ban on the sale of new ICE powered petrol or diesel cars. These bans set clear deadlines, signalling to manufacturers and consumers that fossil fuel-powered vehicles will become obsolete. For example, United Kingdom banned the sale of petrol and diesel cars with ICE engines by 2035, to push the automakers to shift to electric models[22].

   iv. **Low-Emission Zones (LEZs)**: Cities worldwide are introducing low-emission zones where the most polluting vehicles are restricted or charged extra to enter. This policy encourages the adoption of low- or zero-emission vehicles, especially in urban areas where pollution is concentrated. Like, London's Ultra Low Emission Zone (ULEZ) imposes daily charges on vehicles that do not meet strict emission standards, to encourage the adoption of greener alternatives[23].

2. **Incentives for Renewable and Clean Energy Technologies**

   i. **Subsidies and Financial Incentives**: To motivate the consumers and manufacturers to adopt EVs and other alternative energy transport technologies, governments offer subsidies, grants, and tax credits. These policies reduce the cost barrier to entry for EVs, making them more competitive with traditional ICE vehicles. In Norway, electric vehicle buyers enjoy a wide range of incentives, including zero VAT, lower road taxes, free tolls, and free parking in certain areas[24].

   ii. **Tax Benefits**: Policies such as tax exemptions, rebates, and lower registration fees for electric or hybrid vehicles encourage consumers to choose greener alternatives. For example, the U.S. federal government provides a tax credit of up to $7,500 for new electric vehicle purchases, depending on the battery capacity of the vehicle[25].

3. **Investment in Infrastructure**

   i. **Charging Infrastructure for Electric Vehicles**: The availability of widespread and reliable charging infrastructure is important for the transition to EVs. Public policy plays a vital role in financing and coordinating the installation of public charging stations, ensuring that they are accessible and strategically placed. In 2023,

[20] U.S. Department of Transportation. (n.d.). *Corporate Average Fuel Economy (CAFE) standards.*
[21] European Commission. (n.d.). *CO_2 emission performance standards.* Climate action.
[22] Manning, J. (2024). *UK will bring forward ICE car ban to 2030.* Fleet Europe.
[23] Greater London Authority. (n.d.). *The Ultra Low Emission Zone (ULEZ) for London.*
[24] Elbil.no. (n.d.). *Norwegian EV policy: Norway is leading the way for a transition to zero emission in transport.*
[25] U.S. Department of Energy - Energy Efficiency and Renewable Energy, Alternative Fuels Data Center. (n.d.). *Tax credits for electric vehicles and charging infrastructure.*

European Union passed a new law on alternative fuels infrastructure to reduce carbon footprint in Europe. According to the new EU law, fast charging stations to be installed at every 60 kms by the end of 2025.[26]

ii. **Public Transport Electrification**: Governments invest in the electrification of public transport networks, including buses, trains, and trams, to reduce emissions from mass transit systems. This reduces reliance on fossil fuels while providing greener alternatives to individual car ownership. In India, under the Faster Adoption and Manufacturing of Electric Vehicles (FAME) program[27], there is significant investment in electric buses for public transportation.

iii. **Green Hydrogen Infrastructure**: For sectors where electrification is more challenging (such as heavy-duty transport and aviation), public policy promotes the use of hydrogen fuel cells by funding hydrogen infrastructure and research. Such as, Germany is investing heavily in hydrogen infrastructure to fuel hydrogen-powered buses and trains as part of its National Hydrogen Strategy[28].

4. Carbon Pricing and Market Mechanisms

i. **Carbon Taxes**: It is based on the concept of Polluter Pays Principle[29] introduced in Rio Declaration, 1992. Governments impose taxes on carbon emissions from fossil fuel use, creating a financial incentive for transport companies and consumers to switch to cleaner energy sources. By making fossil fuel use more expensive, carbon taxes push businesses to innovate and invest in green technologies. Like, Sweden's carbon tax is one of the highest globally and applies to most fossil fuels used in transport, driving the adoption of biofuels and EVs[30].

ii. **Cap-and-Trade Systems**: In cap-and-trade schemes[31], governments set a limit (cap) on the total emissions allowed within the transport sector. Companies can trade emissions allowances, creating a market-based incentive for firms to reduce their emissions. Such as, the European Union's Emissions Trading System (ETS) includes aviation and aims to reduce GHG emissions through market mechanisms, effectively putting a price on carbon for the aviation sector[32].

5. Support for Research and Development (R&D)

i. **R&D Funding for Green Technologies**: Government provides funds for research and development in clean transport technologies, such as advanced batteries for electric vehicles, biofuels, hydrogen propulsion systems, and energy-efficient engines. Public policies also foster collaborations between academic institutions, private companies, and government bodies to accelerate innovation in green transport. The U.S. Department of Energy funds research on battery technology and energy-efficient vehicles through its Vehicle Technologies Office.

ii. **Pilot Programs and Demonstration Projects**: Public policies often include support for pilot programs that test new green technologies on a small scale before they are rolled out nationally or globally. In 2024, UK government has funded pilot projects for hydrogen-powered buses and green aviation technology through its Industrial Strategy Challenge Fund[33].

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[26] World Economic Forum. (2023, July 27). *New EU law requires fast-charging stations at every 60 kilometers by the end of 2025.*
[27] World Economic Forum. (2023, July 27). *New EU law requires fast-charging stations at every 60 kilometers by the end of 2025.*
[28] Federal Government of Germany, Ministry for Economic Affairs and Energy. (n.d.). *The National Hydrogen Strategy.*
[29] Organization for Economic Co-operation and Development (OECD). (1992). *The Polluter Pays Principle.* Environment Directorate Organization for Economic Co-operation and Development.
[30] Government Offices of Sweden. (n.d.). *Sweden's carbon tax.*
[31] Environmental Defense Fund. (2020, January 22). *How cap and trade works.*
[32] European Commission. (n.d.). *Reducing emissions from aviation.*
[33] Hydrogen in Aviation. (2024, March). *Launching Hydrogen Powered Aviation Report.*

- **Conclusion**

The public policy that supports energy transition is quite fragmented in India. This is primarily due to fact that India's policies focus more on achieving energy security and less on energy transition. In order to provide an uninterrupted supply of energy, India depends on conventional sources of energy meeting its immediate and rising demand for the same. To shift towards newer sources of energy in India, it requires intensive financial and technological support.

Although no specific legal framework or public policy mandates for energy transition, various policies, Acts and regulations pertaining to energy sector promote transition to a low carbon energy mix. Talking about the energy sector, it is regulated by various governmental bodies, such as the Ministry of Petroleum and Natural Gas (MoPNG), Ministry of Coal, Ministry of Power, Ministry of New and Renewable Energy (MNRE). However, to govern energy transition in transport sector, Bureau of Energy Efficiency (BEE) and Ministry of Environment, Forest and Climate Change (MEFCC) promotes various policies in balancing between energy demand as well as production of low carbon energy to mitigate climate change. However, the lack of coordination often leads to fragmented efforts and slow implementation of key initiatives. Also in many regions, regulatory frameworks are not stringent enough to compel rapid emissions reductions in the transport sector. While some countries have introduced carbon pricing, fuel efficiency standards, and emissions reduction targets, there are significant gaps in policy implementation and enforcement, particularly in developing nations.

- **Suggestions**

The findings of this paper have shown that while public policy has made progress, substantial gaps remain in ensuring an effective transition. To navigate these challenges, this paper proposes several policy interventions. A shift toward a circular economy in the transport sector is crucial, encouraging the recycling and reusing of materials to minimize environmental impact. Governments can create tax incentives, subsidies, and grants for companies and consumers adopting clean technologies, such as electric vehicles (EVs), hydrogen-powered vehicles, and hybrid models. Policies like the production-linked incentive (PLI) scheme can accelerate the adoption of these technologies.

Public policies should support the development of necessary infrastructure, such as EV charging stations, green fuelling stations, and efficient public transport systems. Urban policies should promote sustainable mobility, such as use of cycling lanes, pedestrian-friendly areas, and car-free zones, can reduce the need for private vehicle use.

While there are taxes and cess on coal and diesel, India has yet to implement a comprehensive carbon pricing or carbon tax for the transport sector. Enforcing strict emissions standards for vehicles, particularly in urban areas, can significantly reduce pollution. A clear carbon pricing mechanism could create more robust market incentives for businesses and consumers to shift toward low-emission vehicles and fuels.

Another sustainable mobility approach that encourages more efficient, lower-carbon transport solutions is **Avoid-Shift-Improve (ASI) framework.**

- **Avoid:** The "Avoid" component focuses on reducing the demand for transport, particularly private vehicles, by enabling more efficient spatial planning and promoting alternative modes of transportation. The introduction of congestion pricing in urban centers, charging fees for entering high-traffic zones during peak hours can minimize the excessive motorized travel. This disincentivizes private vehicle use in crowded areas. It can be achieved by implementing automated tolling systems and data analytics to monitor traffic patterns and adjust pricing dynamically.
- **Shift:** The "Shift" element focuses on encouraging a transition from private motorized transport to more sustainable options such as public transit, walking, cycling, and shared mobility. Investment in pedestrian infrastructure (sidewalks, pedestrian bridges) and cycling infrastructure advance towards sustainable options. Policy to regulates and incentivize shared mobility services like carpooling, ridesharing, and vehicle-sharing, promotes towards saving of energy.
- **Improve:** The "Improve" component focuses on enhancing vehicle technology and fuel efficiency to reduce emissions from the transport sector. By offering subsidies, tax incentives, and low-interest loans for purchasing

electric vehicles (both private and public transport vehicles). Implementation of strong regulations on emissions standards to phase out high-polluting internal combustion engine (ICE) vehicles is the need of hour.

To ensure the successful implementation of the Avoid-Shift-Improve framework, the public sector must create a holistic policy ecosystem that encourages sustainable behaviour while offering technological support and incentives. The focus should not only be on changing infrastructure and transport options but also on influencing public perception and behaviour through education.

A concerted effort by policymakers, industry participants, and the public will be crucial in accelerating the transition from fossil fuels to cleaner, renewable energy sources. Only through an inclusive and dynamic policy environment can India achieve its dual goals of sustainable development and energy security, setting an example for the global community in the journey from “black” to “green.”