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King Abdullah Petroleum Studies and Research Center

India's Long-Term Low-Carbon Development Strategy: The Decarbonization of its Road Transport Sector

Yagyavalk Bhatt

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About KAPSARC

KAPSARC is an advisory think tank within global energy economics and sustainability providing advisory services to entities and authorities in the Saudi energy sector to advance Saudi Arabia's energy sector and inform global policies through evidence-based advice and applied research.

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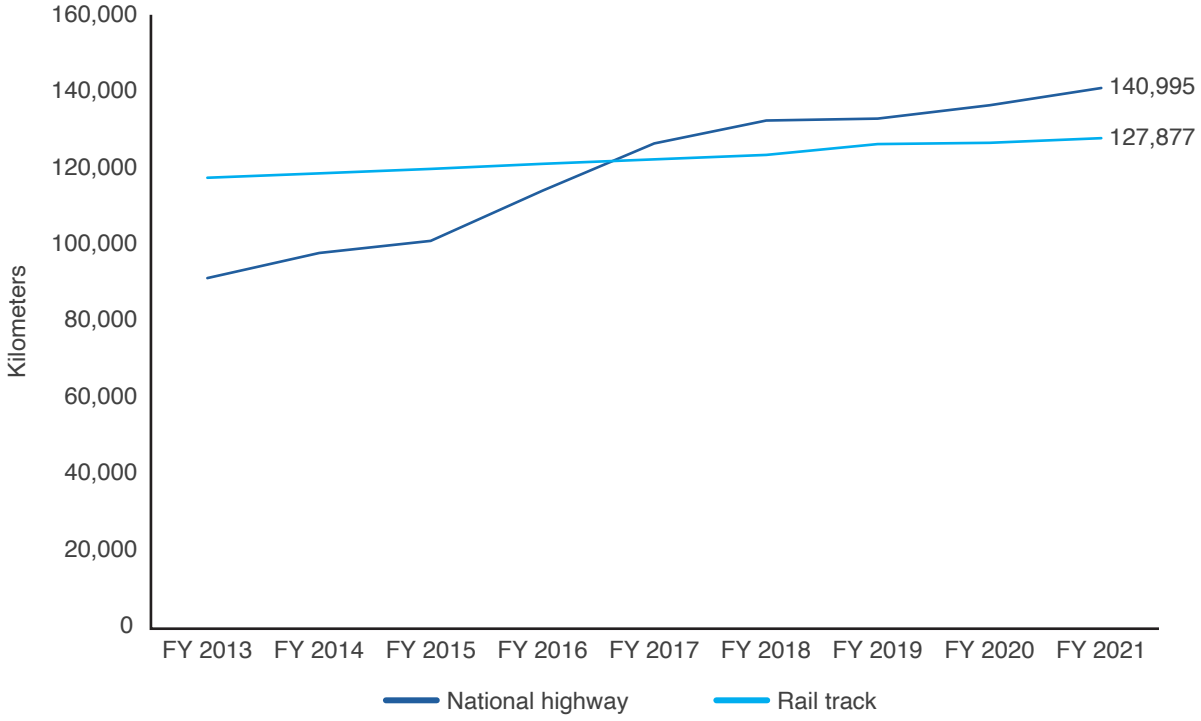
India submitted its long-term low-emissions development strategy (LT-LEDS) to the 27th Conference of the Parties of the United Nations Framework Convention on Climate Change (COP 27) on November 14, 2022 in Sharm El Sheikh, Egypt. The strategy sets out a detailed roadmap of India's commitment toward climate change mitigation efforts and energy security. The strategy provides details of the roadmap that will be taken across the economy to cut greenhouse gas emissions and increase the country's energy resilience. It includes plans to develop the electricity sector, low-carbon transport, sustainable urbanization, and low-emission industrial systems, remove carbon dioxide (CO2) and facilitate related technologies, enhance forest and vegetation cover and finance low-carbon development. The focus of LT-LEDS is the country's climate change commitments and energy. Hence, developing low-carbon transport, especially road transport, is a priority area (Ministry of Environment, Forest and Climate Change 2022).

India's Need for Road Transport Decarbonization

In recent years, India's transport sector has been the fastest growing end-use sector, mainly due to the rapid development of the country's transportation infrastructure, from highways, railways, and metro lines to airports (IEA 2021). To satisfy India's growing road transport demand, the government is constructing and enhancing the road network. It is also undertaking key initiatives, such as Bharatmala, an umbrella program for the highways sector focused on optimizing the efficiency of freight and passenger travel across the country (Ministry of Road Transport and Highways 2022). Further, aside from providing connections to remote areas of India and building new tracks in the process, the government plans to fully electrify its rail network by 2023. As of March 31, 2022, Indian Railways had electrified 52,247 route kilometers (RKMs), representing about 80% of the rail network (Ministry of Railways 2021).

Figure 1. National highway and rail track infrastructure development in India.



Sources: Ministry of Railways; Ministry of Road Transport and Highways.

In the last three years, civil aviation has emerged as one of the fastest growing industries in India. Currently, India has the third-largest domestic aviation market in the world, and it is expected to overtake the United Kingdom to become the world's third-largest aviation market by 2024 (Indian Brand Equity Foundation 2022).

According to the Ministry of Civil Aviation, India will have about 1,200 aircraft and 400 million passengers by 2027. Further, the government has set a target to increase the number of airports from 140 to 220 by 2025. Currently, India has two carbon neutral airports, Delhi and Kochi, and will add 92-93 carbon-neutral airports by 2024 (The Times of India 2022) to achieve its United Nations Nationally Determined Contribution and net-zero targets.

This rapid growth in India's transportation sector could negatively impact its overall emissions and energy security, which is why the government has put forward a roadmap for low-carbon development in its transportation sector. This insight focuses on India's road transport sector since it accounts for the majority of the transportation sector's oil demand and emissions.

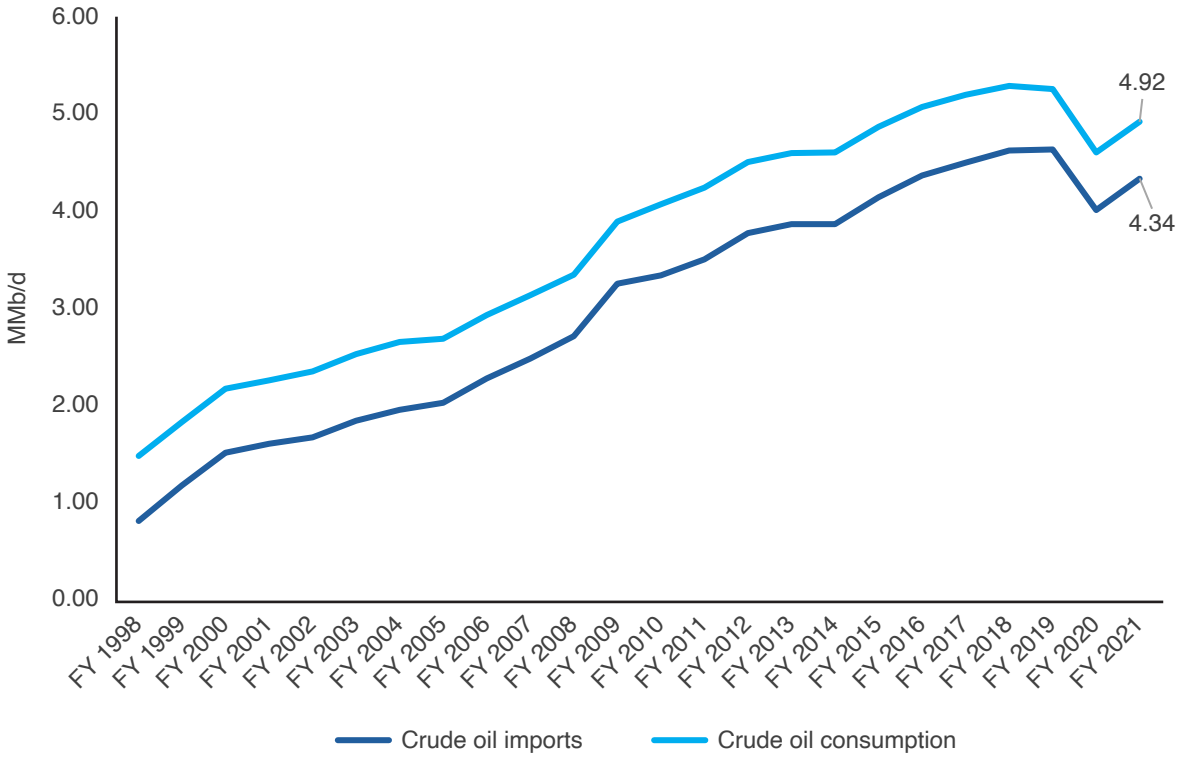
Energy Security

India is the world's third-largest oil consuming country. The transport sector accounts for about 50% of India's oil demand, followed by industry and the residential sector. In the fiscal year[1] 2021-2022, India imported about 88% of its crude oil consumption, with a total import expenditure of about US$119 billion, up from US$62.2 billion in the previous fiscal year (Economic Times 2022a).

Further, as per the International Energy Agency's Stated Policies Scenario (STEPS) or business as usual scenario in its "India Energy Outlook 2021," energy demand from India's road transport is projected to more than double over the next two decades. This demand growth will be fueled primarily by diesel-based freight transport. India's oil demand could rise by almost 4 million barrels per day (MMb/d) to reach 8.7 MMb/d in 2040. This could be the largest demand increase of any country (IEA 2021).

[1] In India, the fiscal year runs from April 1 to March 31.

Figure 2. India's crude oil imports and consumption.

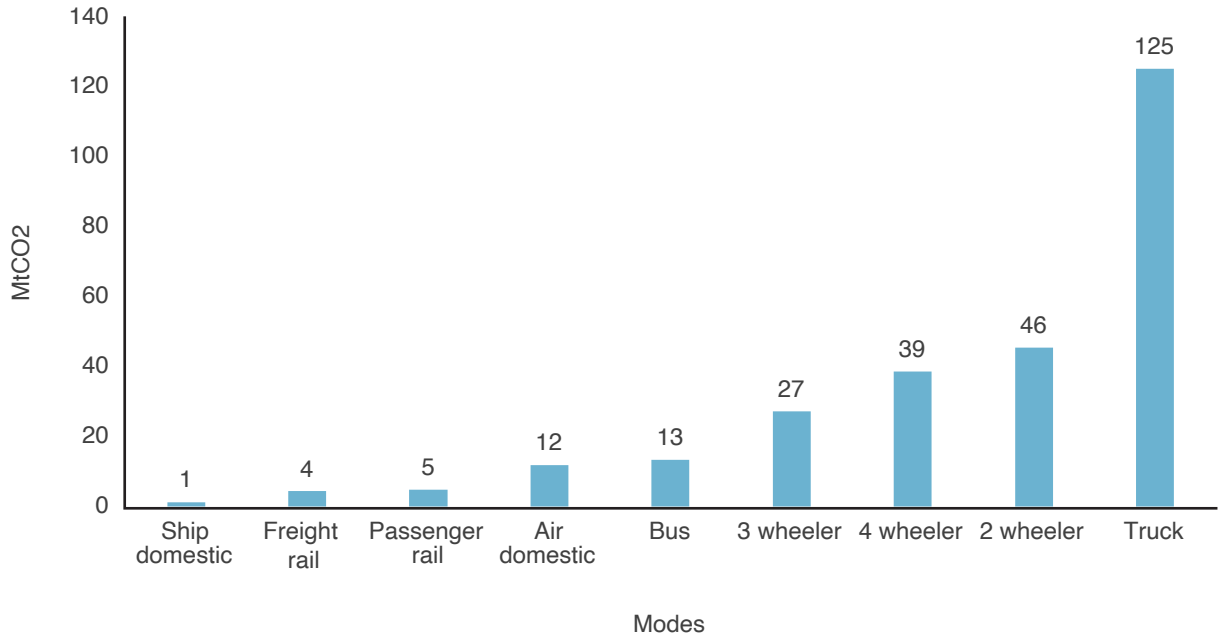


Note: MMb/d = million barrels per day.
Sources: Petroleum Planning & Analysis Cell; KAPSARC analysis.

Emissions

India is the world's third-largest CO2 emitter, and the transport sector is a key contributor to its CO2 emissions. Further, India's transport sector contributes to about 12.1% of the country's energy-related CO2 emissions and 9.7% of the country's total greenhouse gas emissions (Ministry of Environment, Forest and Climate Change 2022). The transport sector's tailpipe emissions (excluding international aviation and international shipping) stood at about 272 million tonnes of CO2 in 2020. Road transport accounted for about 92% of these emissions. Further, India's road transport emissions contribute significantly to its air pollution problem (Kamboj et al. 2022).

Figure 3. Carbon emissions produced by India's transport sector in 2020.[2]



Note: MtCO2 = million tonnes of CO2.
Source: Kamboj et al. (2022).

Therefore, it was very important for India to set a precise goal for road transport decarbonization in a long-term low-carbon development strategy to steer the country toward its climate commitment and energy security goals.

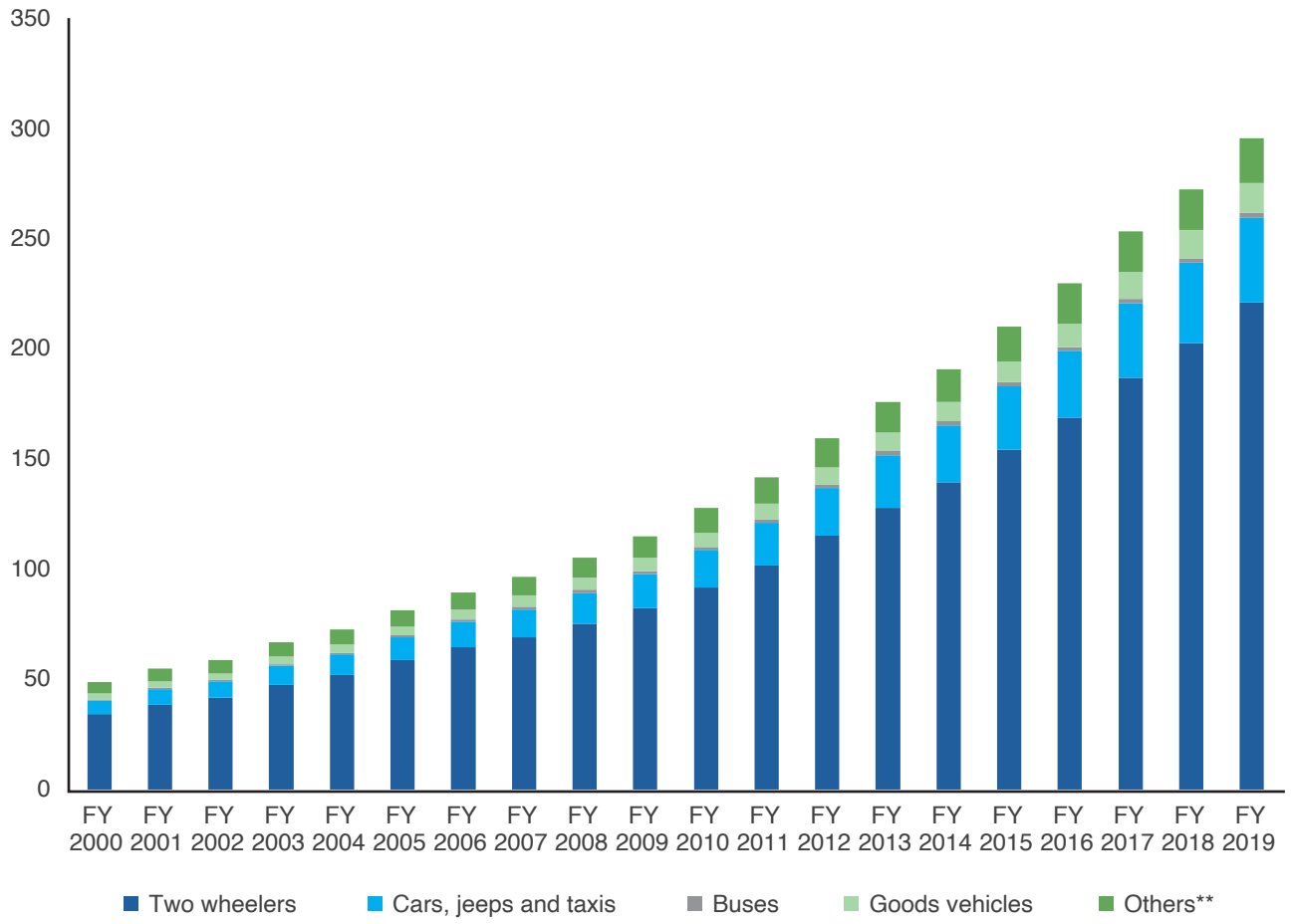
India's Road Transport Decarbonization Strategy in LT-LEDS

An increase in sales of internal combustion engine vehicles in the past decades in India has almost doubled the country's fuel consumption and related emissions of its transport sector, even though vehicle ownership in India is far lower than in other developed and emerging economies. As per Figure 3, the total number of registered vehicles in the country between 2000 and 2019 grew at a compound annual growth rate of 10%. Much of this growth was driven by rapid urbanization, which is expected to continue to increase from about 370 million in 2011 to 600 million by 2030 (Ministry of Finance 2022).

Therefore, India is exploring solutions to decarbonize its transportation sector, especially, road transport, to cater to consumer demand. It also plans to diversify its fuel mix to mitigate climate change and achieve its energy security goals.

[2] Light-duty vehicles, three wheelers, two wheelers, and four wheelers.

Figure 4. Total number of registered motor vehicles in India.



Note: ** includes tractors and three wheelers.
Source: Ministry of Road Transport and Highways.

In the LT-LEDS, India is exploring avenues to strengthen its fuel efficiency regulations through increased electrification and the use of cleaner fuels in the transportation sector. India is also looking to strengthen its existing policies on cleaner fuels to provide a positive market signal to the automotive industry.

Alternative Fuels

India is looking to boost its development plan for alternative fuels in a phased manner.

Phase 1. Using ethanol-compressed natural gas (CNG), biodiesel and liquified natural gas (LNG) as short-term fuel alternatives.

Phase 2. Biodiesel and methanol/dimethyl ether supplemented by pipeline biogas as medium-term fuel alternatives. The following measures would be adopted to encourage the use of such fuels:

1. Boost annual ethanol procurement.

2. Increase ethanol production facilities and ensure the availability of sufficient feedstock.

3. Augment ethanol storage, handling, blending and dispensing infrastructure.

4. Support the manufacture and adoption of more ethanol-compatible vehicles through incentives, tax breaks and other measures.

5. Introduce sustainable aviation turbine fuel and biodiesel at a commercial scale.

Phase 3. Hydrogen as a long-term alternative.

Following the announcement of India's National Green Hydrogen Mission, it is expected that hydrogen could become a significant fuel for the country's transport sector in the medium term (Ministry of Environment, Forest and Climate Change 2022). Hydrogen is considered one of the key future energy carriers, having a variety of potential applications. Therefore, the Indian government is working extensively on developing more technologies to produce green hydrogen and increasing its end-use applications in the transportation sector (Ministry of Environment, Forest and Climate Change 2022).

Further, India may adopt carbon capture, utilization, and storage (CCUS) for coal-based methane and promote the development of coal-to-gas and coal-to-liquid technologies through raising international finance and increasing technology transfer and collaboration. To complement the development of CCUS, the government drafted its "2030 Roadmap for Carbon Capture Utilization and Storage (CCUS) for upstream E&P Companies." The roadmap details guidelines for the dissemination of CCUS technologies for upstream oil exploration and production companies. To implement the roadmap, the Indian government has already identified prospective fields for CO2-enhanced oil recovery (Ministry of Petroleum and Natural Gas 2022).

Public Transport

Apart from alternative fuels, India is also looking to expand its public transport infrastructure through several initiatives to encourage a modal shift in both passenger and freight transport, encouraging the use of public transport to avoid higher per capita emissions. The country has a goal to expand the use of less polluting public transport modes, such as rail, over road and aviation (Ministry of Environment, Forest and Climate Change 2022). The government is building public transportation in highly populated cities to avoid air pollution, excessive fuel consumption and congestion. Metro rail systems have witnessed the fastest growth, from a network length of 222 kilometers (km) in three cities in 2011 to 697 km in 13 cities in 2021. Further, the Indian government has also approved an extension to the metro rail network of 1,032 km that will expand the reach of metro systems to 27 cities (UITP 2021).

The Indian government is also promoting the use of electric buses (e-buses) in urban transport systems. India currently has about 3,000 registered e-buses. However, the government's push for cleaner public

transport and its plan to investment substantially in mobility infrastructure could see the rapid growth of e-buses. Further, Convergence Energy Services, a subsidiary of the state-owned Energy Efficiency Services, is planning a US$10 billion tender for 50,000 electric buses that will drive India's plans to decarbonize public transport and help meet its goals for net-zero emissions (Bloomberg 2022).

India's subnational regions and their governments are also integrating climate action into their development efforts. Ahead of COP 26, the state of Maharashtra announced that 43 of its cities will join the United Nations-led Race To Zero campaign. In 2022, the city of Mumbai in Maharashtra announced detailed plans to eliminate carbon emissions by 2050, making it the first city in South Asia to set such a timeline. Further, other states and regions in India have also introduced carbon neutral plans (Economics Times 2022b).

Electric Vehicles (EVs)

Increasing the adoption of electric vehicles is another initiative India is taking to decarbonize its transportation sector. In the LT-LEDS, India is looking to increase the domestic manufacturing of EVs and EV batteries through production-linked incentive (PLI)[3] schemes. The country will also explore vehicle-grid integration options to enable increased load on the electricity grid, decarbonizing the grid and establishing off-grid renewable hybrid charging and swapping stations for batteries.

India will also consider policies related to the management of EV waste and circular economy principles for the EV sector, and re-skill the workforce to manufacture and operate new EV technologies and related infrastructure (Ministry of Environment, Forest and Climate Change 2022).

Conclusion

The LT-LEDS focuses on the balanced use of domestic resources with due regard to energy security and climate change. To enable a smooth and sustainable transition of the transport sector's migration from crude oil products, the strategy promotes the increased use of biofuels, especially ethanol blended with petrol, increased electric vehicle penetration, and the increased use of green hydrogen. However, the development of new technologies and related infrastructure in the transportation sector will incur substantial costs. With an eye on these costs, the Indian government prepared this strategy to remind the developed countries of their responsibility to provide climate finance to developing countries. The LT-LEDS outlines the assistance that India will require through global cooperation to develop transparent climate finance processes and equitable market mechanisms to fill financing gaps. The Indian government also emphasized the role of climate funds in facilitating technology transfer and to help with the associated costs of these technologies, which will enable India to achieve its targeted deployment of low-carbon climate technologies at a significant scale (Ministry of Environment, Forest and Climate Change 2022).

[3] The Production Linked Incentive (PLI) Scheme for Automobile and Auto Component Industry proposes financial incentives to boost the domestic manufacturing of advanced automotive technology (AAT) products and attract investments in the automotive manufacturing value chain.

India's strategy is designed to adopt any new road transportation technologies that can help it to meet its climate and energy security goals. However, a commitment from developed countries to finance these technologies will be required. India's economic and population growth will be keenly watched globally. Its progress in executing low-carbon pathways could shape the narrative for future global climate engagements and conferences. Further, India's advancement in executing low-carbon pathways for road transport could change the demand side of the global energy market.

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