This report is derived from an extensive secondary literature survey of the alternative vehicle technologies sector including electric vehicles and hybrids in India. The primary aim of the report is to set the context for understanding the current state and future evolution of the sector in the country. Briefly, the policy framework and institutional structure as well as the challenges and opportunities within the sectors are delineated.
ALTERNATIVE VEHICLE TECHNOLOGIES IN INDIA

Background

India has been rapidly ascending on the motorisation curve, especially among the middle class, in the last decade. As a result, both urban traffic congestion and air quality have worsened in all major metropolitan cities and towns. In terms of CO\textsubscript{2} emissions in India, the transport sector contributed around 18% – 77 out of 430 mn tonnes (SMEV, 2012). The dominant vehicle technology is the fossil fuel-based internal combustion engine (ICE). In India, about 70% of petroleum consumption is imported (EIA, 2011) and as a result, the security of energy supplies is always a concern. Therefore, Indian government has been trying to advance alternative vehicle technologies. Some broad categories considered in this report are:

- Electric vehicles (EV)
- Hybrid electric vehicles
- Plug-In hybrid vehicles, and
- Fuel cell vehicles

The existing ICE engines are not very energy efficient and have been developed to their full potential (Sperling & Gordon, 2009). Electric drive technology, which has been present since the beginning of automobile history, is fast becoming a viable form of vehicle technology, replacing ICE and its reducing dependence on associated fossil fuels. Some of the advantages that electric drive technologies have over traditional ICE engines, apart from decreased emissions, are:

- Electric motors are inherently more efficient than combustion engines, effectively utilizing more than 90 percent of the energy provided, compared to the 37 percent in ICE engines. (Sperling & Gordon, 2009)
- No energy is consumed while the vehicle is at rest or coasting.

- Regenerative braking mechanism can be used to capture energy lost during braking. However, electric drive vehicles pose a challenge since they require a change to both the vehicle technology and fuel distribution systems. (Sperling & Gordon, 2009)
- Minimal engine noise and therefore lower ambient noise.

Fuel cell technology, which has been in existence for a long time, has only been investigated for feasibility as an alternative hydrogen-based vehicle propulsion system. Fuel cell vehicles, similar to EVs, do not have any tailpipe emissions, are also quiet and cause no corrosion to the engine.

As the Indian economy grows and urbanisation in Indian cities increases, the use of alternative vehicles technologies to reduce dependency on fossil fuels, and improve ambient air and noise quality will become more and more important.

Market Assessment

The automotive sector market in India employs nearly 13 million people, directly and indirectly. Shown below are the trends in domestic sales in India according to the latest SIAM data (Figure 1).

![Figure 1: Domestic Sales Trends (Source: SIAM, 2012)](image-url)
It can be seen from the above trends that 2-wheelers continue to be the dominant player in the Indian market, and the share of passenger cars is also increasing rapidly.

The electric vehicle market in India is nascent but growing rapidly. According to the latest market reports, the total number of electric two-wheelers on road are about 400,000 and about 1,500 electric passenger cars in India (News Report, Cars21.com).

The only major manufacturer and seller of EV passenger cars in India is Mahindra-Reva, which recently opened a new plant and plans to launch several new models to the Indian and overseas market. Similarly, the only seller of passenger hybrid cars is Toyota Kirloskar. Lohia Auto manufactures electric 3-wheelers, while there are quite a few electric two-wheeler manufacturers including Hero Electric and Electrotherm (News Report, Mint). The Society of Manufacturers of Electric Vehicles (SMEV) estimates two-wheeler makers and importers sold about 100,000 EV units in 2011, which would be about one-tenth of the total scooters sold.

However, many more players are entering the market. Tata, Mahindra, Nissan, Bavina etc. are all either in R&D stages or planning to enter the Indian market along with a host of automotive component manufacturers. Tata and Mahindra have R&D activities also in fuel cell applications in the automotive sector.

**Challenges**

The main challenges to implementation and adoption of electric technologies in India:

- Lack of definite guidelines & regulations and difficulties in physical implementation.
- Lack of an EV charging infrastructure and quality/availability of grid power.
- Low domestic availability of advanced electronics and controls and high-cost of battery technology.
- Requires large investments and therefore considered high risk by stakeholders.
- Consumer acceptance and increasing awareness of the consequences of buying EVs.
- Value added tax (VAT) has also been an issue. EV sales have increased substantially in states where VAT rates have been brought down to 4%. (News Report, Mint)

**Key Drivers for Sector Growth**

The prominent growth drivers for the alternative vehicle technologies market in India are:

- Huge increase in automobile market (as detailed in the Market Assessment section) and further increase forecast
- Government incentives and policies to reduce carbon footprint, reduce transport related emissions and to attract consumer base for alternate vehicle technologies
- Technology factors including availability of spare parts and a vehicle maintenance regime.
- Fuel and energy factors including increasing petrol prices
- Government and industry investment into R&D (Deloitte Report, 2011)

**Policy and Regulatory Framework**

There are various acts that encompass the various modes of transport and regulate transport in India. Automobiles come under the purview of the Motor Vehicles Act (1988). Electric and other alternative motor vehicle technologies have no specific statutes that have been enacted in India.
Government Initiatives:

- In August 2012, the Government of India (GoI) approved a ₹230 billion (€3.5 billion) plan to spur electric and hybrid vehicle production over the next eight years, setting itself an ambitious target of 6 million vehicles by 2020.

- On the recommendations of the Prime Minister’s Group on Technology – Manufacturing of Electric Vehicles in India, a core group was constituted by the Department of Heavy Industry (DHI) in 2009 and a very elaborate policy document was prepared. DHI took approval from the Government for setting up the fully empowered apex body at a very senior level with members drawn from all stakeholders, and for putting this initiative which will encompass all policy related matters on various issues on a mission mode approach.

- Accordingly, the National Council on Electric Mobility (NCEM) was set up. Under the NCEM, a National Board on Electric Mobility (NBEM) was proposed which would go into greater details of the various projects and initiatives that need to be undertaken under this endeavour. Both the Council and Board are serviced by a specialized technical secretariat seated in National Automotive Testing and R&D Infrastructure Project (NATRIP) and the National Automotive Board (NAB). (Outcome Budget, MHI).

- In the 2012 Union Budget, the Finance Minister announced a concessional excise duty of 10% for fuel cell or hydrogen cell technology. The excise duty on a CNG conversion kit has been reduced to 5%, while import of hybrid parts has been exempted from custom duty and a concessional rate of 5% excise has been proposed to incentivise their domestic production.

- Several initiatives including battery-operated Green rickshaws in New Delhi and the Tata Starbus range of buses including hybrid CNG low-floor buses have been introduced. Delhi has also subsidized sales by giving buyers a 15% rebate on the price of the vehicle. (News Report, Mint).

Sources:

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