Transformation of on-road automobiles to electric vehicles in India

Regulatory perspectives

March 2018

KPMG.com/in

Table of contents

1

Executive summary

India's shift to shared, electric and connected mobility could help save up to USD300 billion (INR20 lakh crore) in oil imports and nearly 1 gigatonne of carbon dioxide emissions by 2030

Source: Enabling India's Transition to Electric Mobility, FICCI and Rocky Mountain Institute, Accessed on 7 March 2018

The Indian government has a clear agenda of moving to an Electric Vehicles (EV) only regime, with a complete phasing out of vehicles that are driven by Internal Combustion Engines (ICEs).

The Ministry of Heavy Industries and Public Enterprises had also launched the FAME scheme (Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles in India) in 2015 under the National Electric Mobility Mission Plan 2020 (NEMMP 2020) to promote faster transformation from ICE to EVs. The FAME scheme focuses on a three phased approach to achieve the target of **introducing six to seven million electrified vehicles on Indian roads by 2020.**[1] Subsequently, multiple state governments have been providing incentives to attract electric vehicle (EV) manufacturing in their states, and to fast-track adoption of EVs. Karnataka became the first state of the country to notify an EV policy.[2] Telangana[3] and Andhra Pradesh[4] are expected to release their respective policies in due course. In addition, NITI Aayog's 'Three Year Action Agenda is to be implemented by 2019-20' also emphasises the need to migrate from ICE to eco-friendly automobiles.

There are multiple factors that drive the policy objectives. Key drivers are:

a. Vehicular pollution

Ten Indian cities are among the world's twenty most polluted cities of the world according to the Global Urban Ambient Air Pollution database, 2016. ICEs are one of the major contributors to air pollution emitting high levels of sulphur dioxide and suspended particulate matter amongst other pollutants such as carbon monoxide, ozone, oxides of nitrogen and hydrocarbons.

b. Impact on health in the congested Indian cities

According to State of Global Air 2017 report,[5] India accounts for the second highest number of premature deaths due to air pollution in the world. The Lancet Commission 2017 also ranked India as no.1 in pollution related deaths with air pollution being the biggest contributor. The pollutants emitted from ICE directly affect the respiratory and cardiovascular systems and indirectly result in increased mortality, morbidity and impaired pulmonary function.

c. Impact on balance of payment as oil is the largest imported commodity in India

Of the total oil consumption in the country, nearly 70 per cent of diesel sales and 99.6 per cent of petrol sales occur in the transport sector. The growth in energy demand from this sector outpaces growth in all other sectors and is estimated to reach 280Mtoe (Million tonnes of oil equivalent) in 2040,[6] if the present trend continues. Transition to electric mobility can significantly ease out the pressures of balance of payment.

d. Improved energy security

As per the present trend, India would require nearly 1,600 million metric tonnes oil equivalent of petrol and diesel to fuel its passenger mobility sector between 2017 and 2030. India can save 64 per cent of energy demand from motorised vehicles by pursuing a shared, electric and connected mobility regime resulting in reduction of 876 million metric tonnoes oil equivalent of oil consumption by the year 2030.[7] This could save India more than half of the cost of oil imports

1. National Electric Mobility Mission Plan 2020, Department of Heavy Industry, Ministry of Heavy Industries and Public Enterprises, Government of India, Accessed on 8 March 2018
2. First state to formulate an electric vehicle policy, Money Control, Published on 13 September 2017.
3. Telangana to launch electric vehicle policy next month, Economic Times. Published on 23 November 2017.
4. Electric vehicle policy soon, The Hindu, Published on 19 September 2017.
5. State of Global Air, HEI and IHME, Accessed on 8 March 2018
6. Most pollution-linked deaths occur in India, The Hindu, R. Prasad, Published on 20 October 2017
7. Indian Energy Outlook, International Energy Agency, Accessed on 8 March 2018

by transforming passenger ICE vehicles to EVs by 2030.

e. Mechanism to better utilise cheap solar energy, through the government's National Solar Mission policy

India has set up a 100GW solar power target by 2022. The large scale push is part of the government's 175GW power generation target from renewable sources of energy by 2022. Solar power's duck curve challenge – mismatch between peak demand and solar power production – poses a serious threat to its sustainability. Electric vehicles can be crucial to solar power's success in India. Solar power is only generated during day time and would require a storage mechanism, and that is where lithium-ion batteries of EVs become important. The stored electricity can provide grid stability as solar power generated can be used during peak hours without pushing the grid stability. Further, extensive public charging infrastructure can also increase the demand during the duck 'belly' hours.

Lancet Commission Report has estimated the health implications of air pollution to cost almost three percent of country's GDP

Among the above issues, pollution and health impact appears to be a key driving factor for adopting polices for rapidly moving away from ICE based vehicles and embracing EVs. Therefore, the Government of India has initiated a recent policy effort under the National Health Policy 2017 of Ministry of Health and Family Welfare to target reduction of outdoor air pollution.

It is necessary to have a stronger push towards retrofitting existing vehicles into becoming EV/hybrid and having more hybrid vehicles among the new vehicles that are to be sold, in order to significantly reduce increasing pollution that is impacting human life.

The initial thrust towards hybrids is necessary as higher costs have been deterring customers from buying EVs and cost parity is yet to be achieved. Higher price (chiefly attributable to imported batteries), lack of public charging infrastructure and fewer consumer choices have kept the market penetration for electric vehicles considerably low. Currently, electric vehicles penetration is barely 0.1 per cent in the personal vehicles segment and about 0.2 per cent in the two-wheelers segment.[8]

Costs and infrastructure are among the main challenges being faced by the automobile and electrical and electronics industry to reach the 2030 vision

While the ecosystem for pure electric vehicles is at a nascent stage, hybrid vehicles have a better developed ecosystem. Hybrids essentially utilise the same technology and components as pure electric vehicles. Given this, focus on the hybrid vehicles segment becomes even more important transitioning towards a pure EV regime. Additionally, hybrids have the following to their advantage:

a. Cheaper due to smaller batteries being used

b. No range anxiety as they are not dependent on public charging infrastructure which is hardly present as of now

c. Fuel efficiency because they use battery power intermittently

In the KPMG Global Automotive Executive Survey 2017, 67 per cent of the executives are planning high investments in powertrain technologies for fully hybrid electric vehicles over the next five years in India. Amongst the consumers, 32 per cent said that they would buy a car with FHEV power train technology in the next five years.

Source: Global Automotive Executive Survey, KPMG, Accessed on 8 March 2018

d. Cleaner technology in comparison to ICE

Targeting new vehicle sales to consist of EV/hybrids, the existing on-road vehicles must also be retrofitted to mitigate ill-effects of ICE with immediate effect. A convenient approach to retrofitting is through installation of hybrid retrofit kits. Hybrid retrofits are fast becoming economically affordable with easy installation mechanisms that offer significant savings to the consumers reducing the total cost of ownership. Through considerable improvement in mileage, the capital costs of these devices are usually recovered in less than a year. Economic benefits are combined with nearly 20 per cent reduction in carbon dioxide emissions and considerable decline in overall tailpipe emissions. As less gasoline is used per mile, retrofitted vehicles emit less particulate matters (PM), nitrogen oxides (NO_x), and carbon dioxide (CO_2) than conventional cars. The cleaner nature of retrofitted vehicles makes hybrid retrofits an ideal transitory technology when moving into a fully electric vehicle regime.

8. Achieving energy security country insights based consumption petroleum products, NITI Aayog, Accessed on 8 March 2018

2

Motivations for switching from internal combustion engines to electric vehicles

2.1: Impact on energy security

Road transport in India accounts for 86 per cent of passenger and two-thirds of freight movements.[1] 99 per cent of this sector runs on internal combustion engines powered by petrol or diesel.[2] While domestic production of crude oil is on the decline, growing vehicular traffic has been continuously fuelling demand for oil. During 2005-15, total registered motor vehicles grew at CAGR nearly 9.8 per cent. Specifically, privately owned vehicles segment leapfrogged from 29 million in 2002 to 160 million in 2013 and is expected to be over 500 million by 2030. Figure 1 below is a snapshot of the crude oil consumption and production in India:

2.2: Impact on economy

While the negative impacts of vehicular pollution from ICE on health are significant, these also impact the economy considerably. The crude oil component not only shoots up the import bill but also requires huge expenditure to be incurred by oil refineries and related infrastructure. These are discussed in detail below:

2.2.1: High import bill and substantial hit on foreign exchange reserves

As per the present scenario, India would require nearly 1,600 million metric tonnes oil equivalent of petrol and diesel to fuel its passenger mobility sector between 2017 and 2030, thus exerting huge pressure on the existing foreign reserves.

Figure 1: Crude oil consumption in India

	Unit/ Base	2013-14	2014-15	2015-16	2016-17
Crude oil Production (Domestic)	MMT	37.8	37.5	36.9	36.0
Petroleum Products Consumption	MMT	158.3	165.5	184.7	194.2
Crude oil imports	MMT	189.2	189.4	202.9	213.3
Import Dependency of Crude (on consumption)	%	77.6%	78.5%	80.9%	82.1%

Source: Ready Reckoner, March 2017; Petroleum Planning and Analysis Cell, Accessed on 3 March 2018

India can save 64 per cent of energy demand from motorised vehicles by pursuing a shared, electric and connected mobility regime. This would result in reduction of 876 million metric tonnes oil equivalent of oil consumption by the year 2030.[3] Hence, India could save more than half of the cost of the oil imports by transformation of passenger ICE vehicles to EVs by 2030. The dependency on oil imports could be further reduced by the transformation of private ICE vehicles to electric vehicles.

2.2.2: Capital expenditure for refinery operations and emission standards

The dependency on ICE powered mobility requires heavy capital expenditures in two areas: emission standards and refinery operations.

ICE powered vehicles cause air pollution and government has felt the need to reduce the vehicular emission by moving to more stringent standards. India has

1. India Energy Outlook, International Energy Agency, Accessed on 8 March 2018
2. How India is paving the way for an electric future, Livemint, Published on 17 November 2017
3. Achieving energy security country insights based consumption petroleum products, NITI Aayog, Accessed on 8 March 2018

been following European emission standards with a lag and these standards have been termed as Bharat Stage (BS). BS IV norms are being followed at present. The government has recently decided to skip the BS V standard and advance to the BS VI standard implementation by 2020.[4] Substantial investments are required by the industry and oil companies on a continuous basis to conform to newer emission standards.

According to the industry body, Society of Indian Automobile Manufacturers (SIAM), INR1 lakh crore investment would be required from the automobile industry to switch from BS IV to BS VI standards. It also totals that the shift from BS III to BS IV had required an investment of INR30,000 crore.[5] Furthermore, a part of existing inventory of vehicles usually gets stuck in the transition period making it scrap. In the case of BS IV transition, Automakers had to absorb INR12, 000 crore due to existing inventory of 1.2 lakh BS III vehicles could not be sold.[6]

Oil refineries have to constantly upgrade to meet these standards. **According to a report by the Standing Committee on Petroleum and Natural Gas tabled in the Parliament** in April 2017, Indian oil refineries would require a capital expenditure of INR80,000 crore to meet the new BS standards. It also pointed to the fact that INR20,000 crore were spent to meet the earlier transition to BS III/IV standards. The shift of emission standard directly effects the consumers. **Credit Suisse** estimates that 'BS VI standards will result in approximately 10 per cent rise in ICE prices' in India. The cost of BS VI compliant fuel will cost INR0.25 - 0.30 paisa per liter more.[7]

The increased demand of petrol and diesel has led to expansion of crude oil refinery capacity in India (Refer to figure 2). ICE powered vehicles would continue to push oil Public Sector Undertakings (PSUs) towards investing heavily in expansion of their refining and marketing capacities in order to meet the growing demand. The annual project expansion capital expenditure for oil PSUs has been around INR 75,000 crore in the last few years.

Making India's passenger mobility shared, electric, and connected can cut its energy demand by 64 per cent - NITI Aayog

India can save 64 per cent of anticipated passenger road-based mobility-related energy demand and 37 per cent of carbon emissions in 2030 by pursuing a shared, electric, and connected mobility future. This would result in a reduction of 156 Mtoe in diesel and petrol consumption for that year. At USD52/bbl of crude, this would imply a net savings of roughly INR3.9 lakh crore (approximately USD60 billion) by 2030.

Source: India Leaps Ahead Report by NITI Aayog, Accessed on 8 March 2018

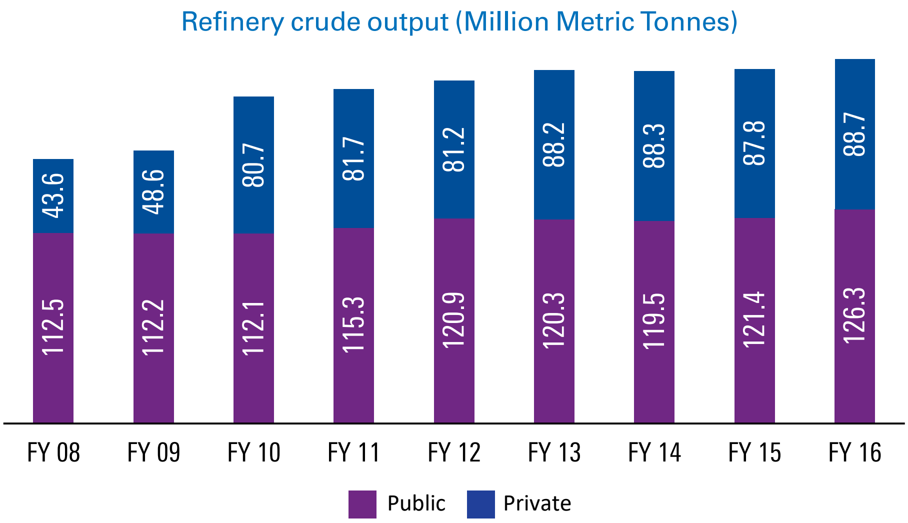
2.3: Impact on environment and health

Internal combustion engines (ICEs) are one of the main sources of air pollution globally. They negatively affect both human health and ecology.

Emissions from ICE powered motor vehicles is responsible for about two-thirds of air pollution in urban area.[8]

World Health Organization (WHO) hosts one of the largest databases of ambient air pollution measurements in cities. Currently, the publicly available WHO Global Urban Ambient Air Pollution Database[9] contains air quality measurements from 3000 cities, representing 103 countries. In the past two years itself, the database has nearly doubled in size, with more cities now measuring air pollution concentrations and recognising the associated health effects than ever before.

Figure 2: Refine crude output by public and private



4. Govt. to implement BS-VI norms by 2020, The Hindu, Published on 22 September 2017
5. Auto industry to invest one lakh crore on new regulations: Siam, Times of India, Published on 9 May 2017
6. SC ban: Auto industry stuck with inventory worth Rs 12,000 crore, Times of India, Published on 31 March 2017
7. Imposing Clean Fuel: BS-VI fuel to cost more, Business Standard, Shine Jacob, Published on 23 November 2017
8. Vehicular Pollution, Their Effect on Human Health and Mitigation Measures, Vehicle Engineering(VE), Shivaji Bhandarkar, Accessed on 8 March 2018
9. WHO Global Urban Ambient Air Pollution Database 2016, World Health Organization (WHO), Accessed on 8 March 2018

The Great Smog of 1952, London

During the Great Smog of 1952, the city of London was brought to a standstill by a dense blanket of toxic smog that reduced visibility to a few feet. For five cold December days, a heavy fog combined with sulfurous fumes from coal fires, vehicle exhaust and power plants, blocking out the sun and creating a public health disaster. The 'Big Smoke' was the worst air pollution crisis in European history, killing an estimated 8,000 to 12,000 people

Source: The Great Smog of 1952, History TV, Published on 6 December 2012

This database also provides inputs to the integrated models that use satellite remote-sensing and chemical transport models to estimate ambient air pollution exposure globally, including estimates for regions without any ground-level monitoring. The Global Urban Ambient Air Pollution Database also supports monitoring of urban air quality for Sustainable Development Goals (SDG)[10] -11.6: 'to reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management'.

According to its Global Urban Ambient Air Pollution Database, more than 80 per cent of people living in urban areas, that monitor air pollution, are exposed to poor air quality levels. As urban air quality declines, the risk of stroke, heart disease, lung cancer, and chronic and acute respiratory diseases, including asthma increases. Some of the major findings about the alarming air quality in India are:

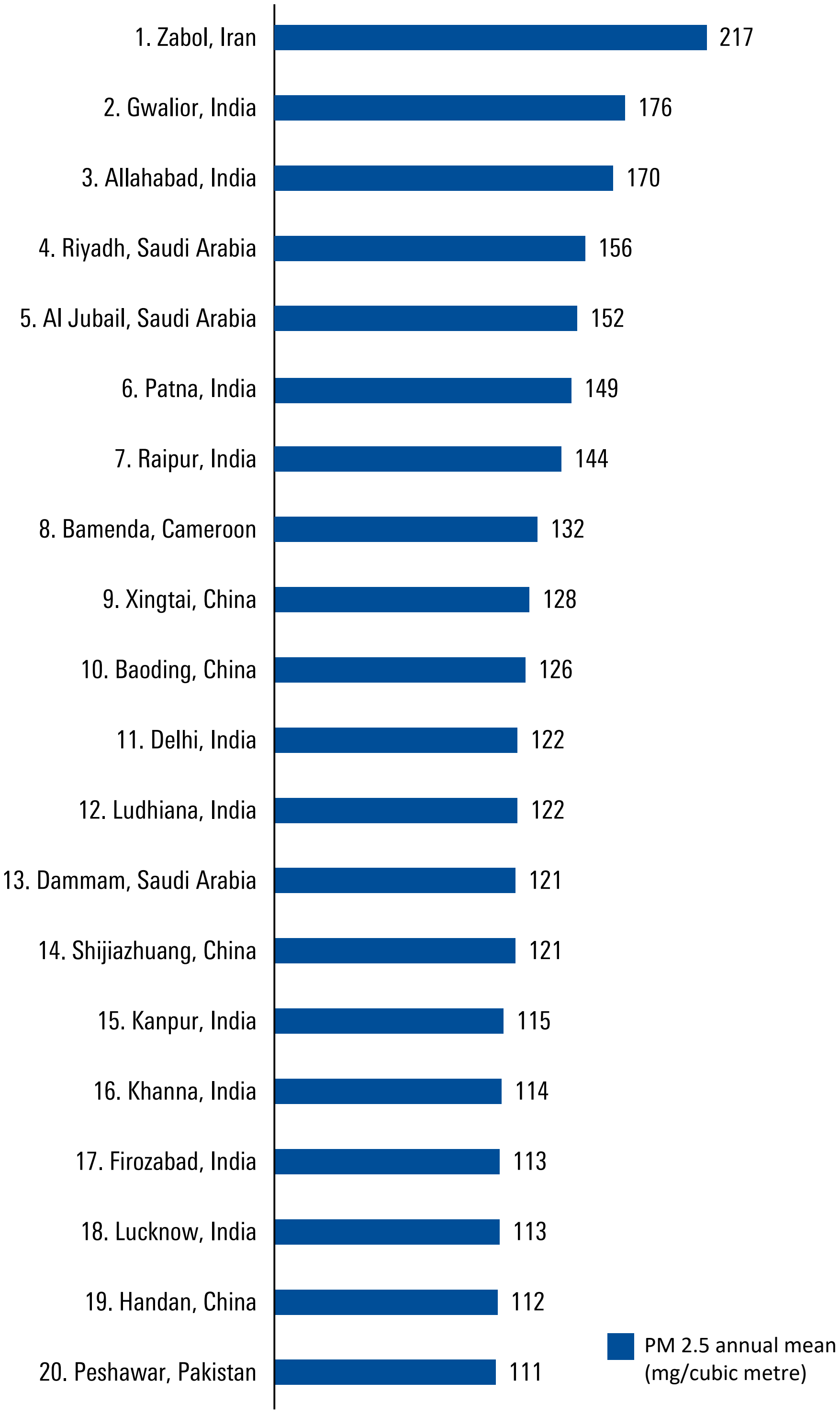
- Four Indian cities are among the world's 10 most polluted cities
- Ten out of the top 20 in the world are also part of the country[11] (Refer to Figure 3)
- Common causes of air pollution include diesel fuelled vehicles, heavy construction activities, temperature control in large buildings and use of coal or diesel generators

The status of ICE pollution contribution in some states of India is as follows (2015):

- **Patna (Bihar):** The annual average concentration of PM10 in Patna's ambient air was recorded at 200 µg/m3 (2015). **Motor vehicles contribute to about 13-22 per cent** of air pollution in Bihar, whereas road dust contributes to 14-19 per cent. Centre for Environment and Energy Development (CEED) had found out that the measures of PM 2.5 and PM 10 are 17 times higher than the safety limits set by WHO.[12]
- **Kanpur, Uttar Pradesh:** There are several important sources of PM10 in the city including industrial point sources (nearly 26 per cent), industry area source (nearly seven per cent), **motor vehicles** (nearly **21 per cent),** domestic fuel burning (about 19 per cent) paved and unpaved road (approximately 15 per cent), garbage burning (nearly five per cent) and others. In Kanpur, nearly 50 per cent of oxides of nitrogen emissions are attributed to motor vehicles.[13]
- **Delhi:** TThe PM10 concentrations are 268 µg/m3 for the year 2015, which were 4.5 times higher than the NAAQS annual limit set by CPCB and about 13 times the annual limit set by World Health Organization for PM10.[14] **Air pollution from motor vehicles is one of the top four contributors** to the hazardous PM10 emission level in Delhi.
- **Maharashtra:** The PM10 concentrations were hazardous and very high most of the year for 2015 for all the cities. Most of the cities had crossed the annual average of 100 µg/m3 PM10 level in 2015. In Pune, approximately **18 per cent of the PM10 emission comes from motor vehicles, whereas motor vehicles contribute to nearly 95 per cent of NO_2 emissions.** They also contribute to high levels of NO_2 in the ecosystem.[15] 'The major cause of pollution in Pune is transport. Its emission has increased by approximately 12-15 per cent in the past three years,' - System of Air Quality Forecasting and Research (SAFAR) programme director and Indian Institute of Tropical Meteorology (IITM) scientist Gufran Beig.[16]
- **Tamil Nadu:** Within the city of Chennai, Central Pollution Control Board, 2011 highlighted that the share of vehicular exhaust emissions was nearly 14 per cent.[17]
- **Telangana:** Motor vehicles contribute significantly on particulate matter levels for both **PM10 (22 per cent) and PM2.5 (31 per cent).[18]** Other major identified sources of particulate matter were industrial emissions, combustion and refuse burning.

10. Sustainable Development Goals, United Nations Development Programme, Accessed on 8 March 2018
11. WHO Global Urban Ambient Air Pollution Database, World Health Organization, Assessed on 6 March 2018
12. Airpocalypse, Greenpeace, Accessed on 8 March 2018
13. Air Quality Assessment, Emissions Inventory and Source Apportionment Studies for Kanpur City, IIT Kanpur, Sharma, Accessed on 8 March 2018
14. Air pollution causes 12 lakh deaths in India annually; Delhi most polluted, Economic Times, Published on 11 January 2017
15. Airpocalypse, Greenpeace, Accessed on 8 March 2018
16. Vehicles contribute most to air pollution, Times of India, Published on 6 March 2018
17. Airpocalypse, Greenpeace, Accessed on 6 March 2018
18. Airpocalypse, Greenpeace, Accessed on 7 March 2018

Figure 3: Ten cities out of top twenty cities which are exposed to high levels of air pollution are from India



Source: WHO Global Urban Ambient Air Pollution Database, World Health Organization, Assessed on 6 March 2018

The emissions from ICE powered vehicles have damaging effects on both human health and ecology. The health effects may be direct as well as indirect ranging from reduced visibility to cancer and death. The specific health effects of ICE pollutants are as below:

- **Carbon monoxide (CO):** It is a colorless poisonous gas that displaces oxygen from the blood. Exposure to elevated CO levels is associated with the impairment of visual perception, work capacity, manual dexterity, learning ability and the performance of complex tasks. High levels of exposure of CO can also lead to death.
- **Hydrocarbon compounds (HC):** It consists of carbon and hydrogen and includes a variety of other volatile organic compounds (VOCs). Hydrocarbons (HC) are mostly relatively harmless by themselves but result in photochemical smog in the atmosphere. Some HCs, such as benzene, are known carcinogens (substance that promotes the cancer disease).
- **Oxides of Nitrogen (NO_x):** They contribute to increased susceptibility to infections, pulmonary disease, impairment of lung function and eye, nose and throat irritations. Short-term NO_2 exposures have resulted in a wide-range of respiratory problems in school children; cough, runny nose and sore throat are among the most common.
- **Ozone (O_3):** It an important component of smog and a highly reactive and unstable gas capable of damaging the linings of the respiratory tract that can cause lung inflammation, shortness of breath,

chest pain, wheezing, coughing and exacerbation of respiratory illnesses such as pneumonia and asthma. Long-term exposure has been linked with chronic respiratory illnesses. Approximately 142,000 people died as a result of exposure to ozone in 2010 – an increase of about six per cent since 1990.[19]

– **Sulphur dioxide (SO_2):** It irritates the nose, throat, and airways and causes coughing, shortness of breath or a tight feeling around the chest area. Excessive exposure of SO_2 leads to asthma, COPD or other respiratory conditions.

– **Particulate Matter (PM):** It is most closely associated with increased cancer incidence, especially lung cancer. They are highly carcinogenic and have been classified in Group I carcinogen because of their ability to penetrate deep into the lungs and bloodstreams and can also cause permanent DNA mutations, heart attacks, and premature death. Exposure to particulate matter in both cities and rural areas was estimated to cause three million premature deaths worldwide in 2012 due to cardiovascular and respiratory disease, and cancers.[20] With every increase of 10 µg/m3 in PM2.5 concentration, 36 per cent increase in lung cancer was observed.[21]

The Lancet Commission on Pollution and Health Report 2017

According to the 'The Lancet Commission on Pollution and Health report 2017' , India has been ranked no. 1 in pollution related deaths with 2.51 million deaths in 2015. India accounted for about 28 per cent of an estimated nine million pollution linked deaths worldwide in 2015.

Source: The Lancet Commission on Pollution and Health Report 2017, The Lancet, Accessed on 8 March 2018

According to the Institute for Health Metrics and Evaluation (IHME), 1.6 million deaths in India are linked to air pollution (2016).[22] Also, 'A global assessment of exposure and burden of diseases'[23] by WHO states that the total deaths attributable to Ambient Air Pollution (AAP) (Year 2012) in India is 6, 21,138 which includes the following:

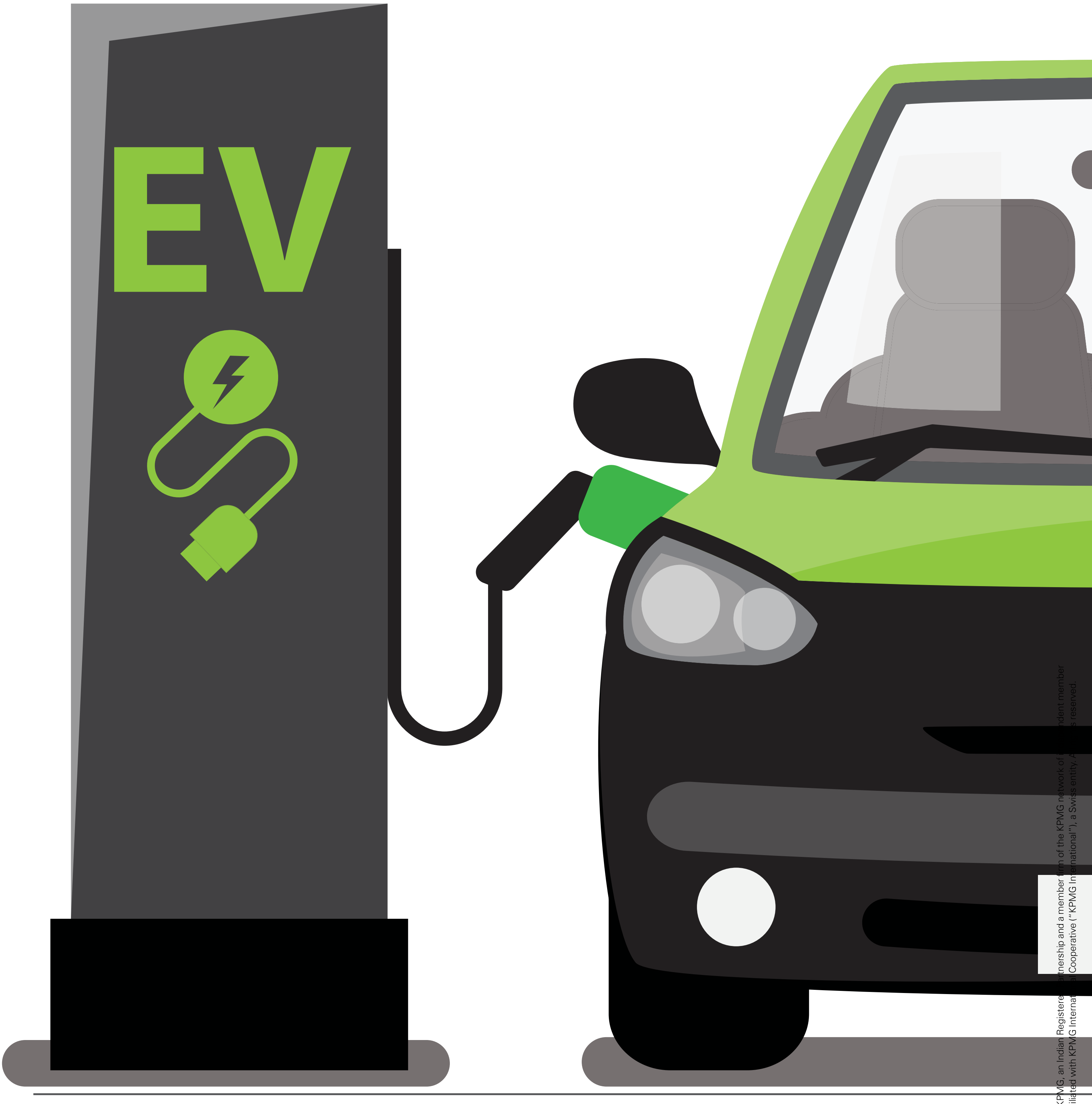
The 2016 Environmental Performance Index (EPI)[24] ranked India 141 out of 180 countries surveyed. EPI is unique in its approach because it incorporates many high-priority environmental issues, including resource consumption, depletion of environmental assets, pollution, and species loss among other important topics.

According to **Global Burden of Diseases 2015,**[25] Ambient PM2·5 ranked among the top ten risk factors for mortality in each of the world's most populous countries. China and India combined had the largest numbers of attributable deaths and Disability Adjusted Life Year (DALY): 52 per cent and 50 per cent of the respective global totals. Pakistan, India, and Bangladesh had the highest age-adjusted mortality rates, more than seven times higher than those of Japan and the USA.

Various studies[26] have revealed that motor vehicle emissions (ICE) result in adverse health effects, including carcinogenicity, mutagenicity, cardiovascular mortality and the aggravation of health in the vulnerable group such as people with compromised health conditions like asthmatics, children and elders.

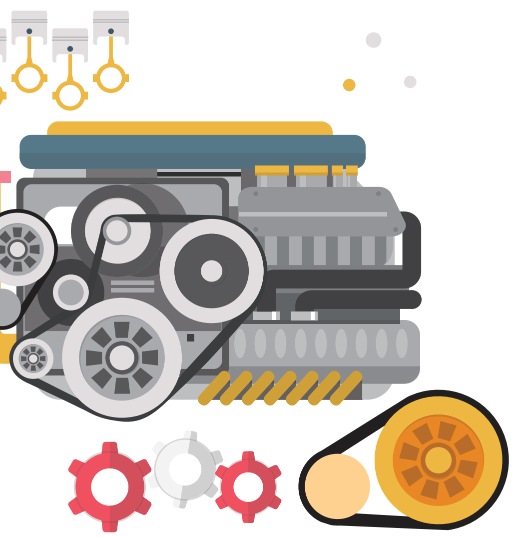
Diseases due to Ambient Air Pollution (AAP)	Acute lower respiratory infections	Chronic Obstructive Pulmonary Disease (COPD)	Lung cancer	Ischemic heart disease	Stroke
India	39,914	11,05,00	26,334	2,49,338	1,95,001

19. State of Global Air (Pollution) Report 2017, Institute for Health Metrics and Evaluation's Global Burden of Disease Project and the Health Effects Institute, Accessed on 8 March 2018
20. Ambient (outdoor) air quality and health, World Health Organization (WHO), Accessed on 8 March 2018
21. Prospective analyses from the European Study of Cohorts for Air Pollution Effects (ESCAPE), Danish Cancer Society Research Center, Accessed on 8 March 2018
22. Indian Leaders Move to Tackle Growing Costs of Air Pollution, National Research Development Corporation, Published on 2 November 2017
23. Ambient air pollution: A global assessment of exposure and burden of disease report, World Health Organization, Accessed on 8 March 2018
24. 2016 Environment Performance Index (EPI) data, Yale University, Accessed on 8 March 2018
25. Global Burden of Disease Study 2015, The Lancet, Accessed on 8 March 2018
26. Effects of air pollution on the respiratory health of children: a study in the capital city of India, Siddique, S., Ray, M.R. and Lahiri, T, Accessed on 5 March 2018


EV

3

Mitigating impacts of internal combustion engines



There have been several policy initiatives to curb air pollution such as increased focus on Preventive and Promotive healthcare in the National Health Policy 2017 by the Ministry of Health and Family Welfare and NITI Aayog's 'Three Year Action Agenda to be implemented till 2019-20' which emphasis the need to migrate from ICEs to eco-friendly measures. Ratification of the Paris Agreement by India in 2016 is another important step towards mitigation of ICEs that emit greenhouse gases.

One of the major focus areas of the government has been movement towards electric vehicles. The electric vehicle market in India is at a nascent stage, hence, policy support is necessary. With the launch of National Electric Mobility Mission Plan 2020 (NEMMP 2020) 2013 under the Department of Heavy Industries, India set out ambitious targets for its automobile industry. Targeting six to seven million electric/hybrid vehicles in the country by 2020, the policy outlined thorough measures including demand and supply side incentives, promotion of R&D in battery technology, power electronics, motors, systems integration, battery management system and testing infrastructure, promotion of charging infrastructure and encouragement to retro-fitment of on-road vehicles with a hybrid kit.[1]

3.1: Faster Adoption and Manufacturing of Electric Vehicles (FAME)

The FAME scheme was introduced in 2015 under NEMMP with an objective to 'support hybrid/electric vehicles market development and manufacturing eco-system'.[2] The focus areas included technology development, demand creation, pilot projects and charging infrastructure. The first phase of the scheme was implemented during 2015-17 and covered both hybrid and electric technologies. In the second phase of the scheme, however, mild hybrids were excluded from the scheme. Over 1.7 lakh vehicles have received subsidy worth INR203 crore under FAME so far. At present, the subsidy for two-wheelers range from INR7,500 to 22,000; for three-wheelers from INR25,000 to 61,000; and for four wheelers from INR13,000 to 610,000.[3]

3.2: NITI Aayog's Three Phased approach for adoption of EV/ HEV

In June 2017, the implementation of NEMMP and FAME was allocated to NITI Aayog.[4] NITI Aayog has since spearheaded the government's goal to move towards all electric cars sale by 2030. The government's premier think tank has developed a three-phased approach focusing on system integration, shared infrastructure development and scaled manufacturing. It has advocated for a fee - rebate policy in which inefficient vehicles would incur a surcharge and efficient ones would get rebates. It has also released a proposal for 'quick pilot' for development of vehicle infrastructure in Delhi.[5] Overall, NITI Aayog has had multiple consultations and is expected to come up with a comprehensive policy that would help create and foster the EV ecosystem by aligning the demand and supply side interests including in the areas of lithium-ion battery and charging infrastructure.

1. National Electric Mobility Mission Plan 2020, Department of Heavy Industry, Ministry of Heavy Industries and Public Enterprises, Govt. of India, Accessed on 4 March 2018
2. Fame India Scheme, Ministry of Heavy Industries and Public Enterprises, Published on 23 November 2016
3. National Mission on Electric Mobility, FAME India, Accessed on 5 March 2018
4. Electric vehicles project FAME moved to NITI Aayog, Economic Times. Published on 19 June 2017 ; NITI Aayog releases proposal for a quick pilot on EV charging infrastructure in Delhi, NITI Aayog, Published on 10 November 2017
5. NITI Aayog releases proposal for a quick pilot on EV charging infrastructure in Delhi, NITI Aayog, Published on 10 November 2017

3.3: State electric vehicle policies

Consequent to the government's push to all electronic vehicles by 2030, multiple state governments have taken initiatives to attract EV manufacturing in their states, and to fast-track adoption of these vehicles. Karnataka became the first state of the country to notify an EV policty.[6] Gujarat, Telangana[7] and Andhra Pradesh[8] are expected to release their respective policies in due course. The policies thus far have included incentives to manufacturers and private players to set up charging infrastructure. Nagpur became the first city recently with availability of mass e-mobility options ranging from e-rickshaws, e-taxis to e-buses.[9] Gujarat is already home to major car manufacturers and multiple car makers have plans to manufacture electric cars from their production facilities in the state.[10]

3.4: Government procurement of electric vehicles

The Central Government plans to replace its entire fleet of 5.5 lakh vehicles with electric vehicles in the coming four to five years to provide a thrust to investments in the EV eco-system.[11] As an initial plan, a tender of 10,000 electric vehicles in sedan car category has already been awarded and the delivery would be completed by 2018. A 20,000 electric vehicle tender is expected to come out in early 2018. The government is also procuring chargers for installation at public places. Further, a scheme to incentivise cities with population of over one million for promoting the use of electric vehicles with subsidies on procurement of electric cars, city buses, as well as three-wheelers has already been notified.

6. National Electric Mobility Mission Plan 2020, Department of Heavy Industry, Ministry of Heavy Industries and Public Enterprises, Govt. of India, Accessed on 4 March 2018
7. Fame India Scheme, Ministry of Heavy Industries and Public Enterprises, Published on 23 November 2016
8. National Mission on Electric Mobility, FAME India, Accessed on 5 March 2018
9. Electric vehicles project FAME moved to NITI Aayog, Economic Times. Published on 19 June 2017
10. NITI Aayog releases proposal for a quick pilot on EV charging infrastructure in Delhi, NITI Aayog, Published on 10 November 2017
11. NITI Aayog releases proposal for a quick pilot on EV charging infrastructure in Delhi, NITI Aayog, Published on 10 November 2017

3.5: Battery swapping

Significant consideration has been given by the government on battery swapping as a mechanism to mitigate the issues of (a) cost of ownership and (b) range anxiety faced with electric vehicles.

A Battery Swapping Infrastructure essentially supports swapping of discharged batteries in a vehicle with fully charged batteries from a shelf. A key advantage of battery swapping is the reduced time for energy replenishment in EVs as battery swap can be possible within 5-15 minutes compared to up to eight hours required for charging a battery. This strategy of providing widespread battery swapping model is also expected to contribute to reducing the upfront cost of EVs as vehicles can be sold with a battery available on lease.

– Battery packs have been a major cost driver for EVs since their inception. Technological developments, widening application base, and economies of scale have pushed down their prices substantially.

– Intense price competition is further fuelling technological advancement efforts in form of development of new formulations and improved processes that are further expected to decrease the lithium-ion battery prices to USD109/KWh and USD73/ KWh by 2025 and 2030 respectively.

– Charging technology has improved by leaps and bounds since the first electric car was launched in India at the cusp of the new millennium. As technology evolves further, charging time is expected to become less than the time required to refill a petrol tank in a current combustion engine vehicle.

While, the above policy measures support India's movement towards cleaner mobility, they do not seem to be adequate. This is evident in the report by Lancet Commission on Pollution and Health which states that India and Bangladesh have had maximum increase in deaths due to pollution. The results of a study published by the Government of India estimates that air pollution led to nearly 620,000 early deaths in 2010 and cost about three per cent of India's GDP in terms of impact on health.[12]

Even the battery swapping model given by NITI Aayog suffers from limitations. Battery Swapping Model does not fall in the **Evolution Path** of battery technology. The rationale for battery swapping model are (a) low energy density of batteries leading to low range of batteries that require frequent charging in a day, (b) long time taken for charging and (c) high cost of battery ownership. However, all these rationales are expected to rapidly fade away in the next five years, as techno-economic development makes batteries cheaper, with significantly higher energy capacity for longer range and with ability to recharge in a very short period of time. Therefore, any investments into battery swapping infrastructure, is likely to become redundant within the next five years.

- **Commercial failures globally:** 100 per cent EV sales and adoption amongst Indian consumers is only possible if a consumer experiences continuity and certainty. Prominent battery swapping companies, including Better Place – the pioneer of battery swapping model, have failed in the past to sustain operations.[13]
- **Add to the costs:** As per NITI Aayog, in 2030 alone over 4.5 crore battery packs will be required for motorcycles, scooters, auto-rickshaws, cars and jeeps. 12 A battery swapping model will only increase the battery pack requirement and add a 'multiple' to the cost as raw material in the form of mineral reserves will continue to be imported. Costs of the additional battery, swapping of battery, storage, asset under-utilisation and profit by the commercial entity involved (and possibly higher electricity rate due to commercial operations and higher GST for batteries) will have to be absorbed by the vehicle owners using battery swapping models.
- **Absence of battery standardisation:** While standardisation has been largely achieved for other applications of lithium-ion battery packs such as electronic devices, it is still to be achieved for EVs as the industry is at a nascent stage and still evolving. In the long run, standardisation has to be achieved since the battery packs would need to find secondary usage once it is no longer fit for EV usage. However, till there is reasonable homogeneity and consistency in operational procedures, it will be difficult to efficiently implement battery swapping models.
- **Practical and safety issues:** There will always be concerns around safety as battery swapping will involve regular/daily interference with the original structure of the vehicle with a critical component getting changed every day.

12. Automobiles and Pollution in India, Open Government Data Community, Published on 5 January 2016
13. Why Better Place failed with swappable batteries—and your cars might just use them one day, Quartz, Published on 1 June 2013

4

Potential road map for future mobility

4.1: Option of pure electric vehicles

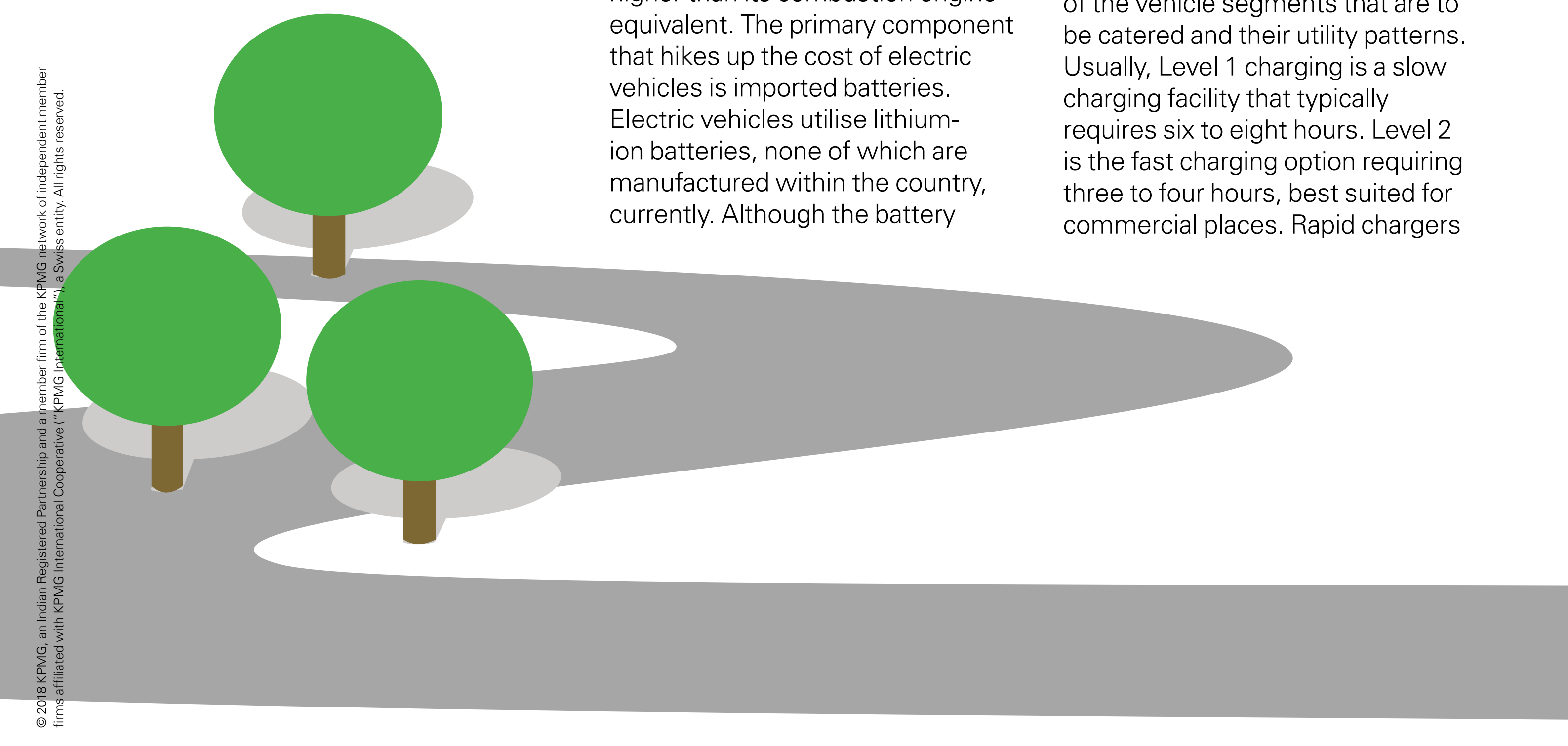
As the Indian automobile industry aims to be among the world's top three in automobile manufacturing by 2026, e-mobility presents just the right opportunity to do so. Aligned with growing environmental concerns, movement towards electrification of fleet also ensures greater energy security for the country. However, electric mobility as a technology is at its nascent stage in India and the path to its successful implementation has multiple challenges. Presently, pure electric vehicle penetration in India is barely 0.1 per cent in private vehicles, about 0.2 per cent in two-wheelers and nearly zero for commercial vehicles.

4.1.1: Lack of price parity

One of the biggest challenges slowing down the rate of EV penetration is the higher cost of these vehicles. A typical electric vehicle costs nearly 2 to 2.5 times higher than its combustion engine equivalent. The primary component that hikes up the cost of electric vehicles is imported batteries. Electric vehicles utilise lithium-ion batteries, none of which are manufactured within the country, currently. Although the battery prices have fallen from nearly USD1000 per kilowatt hour in 2010 to roughly USD250 in 2017,[1] the reduction in price is not sufficient to make these competitive when compared to internal combustion engines. Forecasts suggest that electric vehicles will achieve price parity with ICE-powered vehicles only by 2025. The government is providing subsidies under FAME to electric vehicles in order to incentivise demand; however, direct financial support by the government has its constraints given the sheer volume of the transactions. Also, per charge range offered by EVs poses a concern and any attempts to increase the range requires battery capacity to be increased again leading to widened price gap.

4.1.2: Lack of infrastructure

With charging stations limited to barely 100 across the nation, uninterrupted charging becomes a concern. Creating public charging infrastructure itself is a complex process. It requires deep analysis of the vehicle segments that are to be catered and their utility patterns. Usually, Level 1 charging is a slow charging facility that typically requires six to eight hours. Level 2 is the fast charging option requiring three to four hours, best suited for commercial places. Rapid chargers



are the Level 3 required to be installed at highways and long routes. They take about 30 minutes. Further, it is important to determine the model for operation of the charging stations. Globally, there are two kinds of models in operation – Independent Electric Mobility model, wherein market players set up charging stations and charge the necessary fees for the same; and Integrated Infrastructure Market model, where installation and operation of charging stations is regulated and mostly undertaken by the government, although a third-party service provider may be contracted for the same.[2]

Charging infrastructure additionally requires electricity grids to be upgraded enabling them for additional load taking, simultaneously ensuring that electricity production is through environment-friendly, renewable means.

Efficient movement towards electric mobility would necessitate integrated development of renewable sources of energy as well.

4.1.3: Lack of demand and supply management

Another challenge at hand is the lack of choices available to the consumer in short-term. There are limited models available in the market right now. In the two-wheeler segment, there is an added concern that the market might get flooded with cheaper Chinese imported models with limited features worsening the case for EVs.

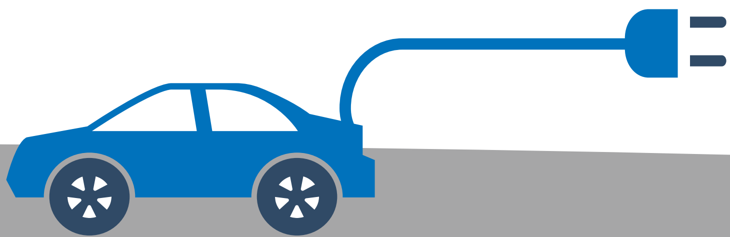
On the supply side of things, broadly, there are four components of electric vehicles that need attention - battery cost and manufacture, motor and drive, control systems and assembling. As a key component, battery manufacturing must be well understood and the supply chain for it must be well established for simpler transition by automobile companies. The key is to reduce battery cost for competitive pricing and entail mass production of these. A critical challenge to overcome in this direction is to safeguard long- term supply of minerals such as lithium, aluminium, cobalt, manganese, and nickel. India has small reserves of these minerals and long-term partnerships would have to be forged or acquisitions would have to be made either by the government or private players in the space.

Powertrain is the second integral component, which must be adequately developed to ensure electricity powered drive systems. The current norm is to import motors from China, which increases the dependence on rare-earth magnets. The third aspect, control systems requires large scale development of electronics and electrical systems within the country that ensure smooth electric traction and motoring, speed regulation and recapturing of braking power. While the knowledge is developed and available, experimentation and testing of this technology indigenously is important to ensure design robustness and cost efficiency. The last element is assembling of the electric vehicle and integration of battery, motor and drive and the remaining parts. While knowledge is essential, the systems must be well developed for installation and cabling. This requires experimentation and hence time, to ensure feasibility of the engineered process in large scale production and its reliability over the life of the vehicle.[3]

4.1.4: Other concerns

On a developmental side, EVs have raised concerns about employee shedding. In comparison to an ICE, a typical EV has barely 1 per cent moving parts. Movement towards electric mobility would therefore imply job cuts specifically in workshops and dealerships. Also the existing workforce needs to be upskilled and revamped to cater to demands of workforce requirements for electric vehicles. Overall, development of knowledge and its disbursement, gestation period for development of infrastructure and large scale implementation of the developed processes are impediments to realisation of electric mobility. While continually rising health and environmental concerns arising out of high deployment of ICEs are pushing for their mitigation, the long drawn process of electric mobility implementation compels for alternatives.

Evidently, India can adopt the vision of all-electric or all-hybrid, in the future. The former finds a strong case in cleaner technology, lower operating



1. Why battery costs could put the brakes on electric car sales, Bloomberg Technology, Chisaki Watanabe, Published on 29 November 2017
2. Long way to go for electric mobility, Financial Express, RN Nayak, Published on 20 August 2016
3. EV Landscape and Future Forward: Bringing Clarity in Commotion, Economic Times, Published on 7 November 2017

costs and overall energy security benefits. The case for hybrids is discussed below.

4.2: Option of hybrid vehicles/ plug-in hybrid vehicles

In the KPMG Global Automotive Executive Survey 2016, 60 per cent of the surveyed executives indicated hybrid electric vehicles (HEV) as their top priority area for investment in powertrain technology. Emphasising the hybrid powertrain technologies as no. 1 investment priority, OEMs correspond well to consumers' demand. They ranked hybrid electric vehicles no.1 as the next purchasing choice, combining alternative powertrain with a common internal combustion engine. Moreover, consumers prefer hybrids over downsized ICE cars, probably because they cater to their needs for fuel efficiency and environmental friendliness.

The following year, in the KPMG Global Automotive Executive Survey 2017, the sample for India comprised of 66 executives and 138 consumers. Of the total, 67 per cent of the executives are planning high investments in powertrain technologies for fully hybrid electric vehicles for over the next five years. Amongst the consumers, 32 per cent said that they would buy a car with FHEV power train technology in the next five years. This may be contrasted with barely 9 per cent of consumers preferring BEV powertrain for their next car.

Hybrids offer the benefits of electrification while still being appropriate for daily use. Combining lower costs with longer range and higher reliability, hybrids have a more developed infrastructure than electric vehicles. However, with technology for fully electric vehicles already developed – digitised, cleaner and more efficient, hybrid electric vehicles are more of interim technology to move towards a fully electric regime.

4.3: Option of hybrid retrofits

Hybrid retrofits are kits that work on a dual energy mode - battery power as well as fuel power. Reasonable and easy to install, hybrid retrofits are grid-independent products that do not require any external charging. Offering substantial fuel and tailpipe emissions saving, hybrid retrofits are the ideal transitory technology.

India's movement towards e-mobility has been slow and while it is still trying to catch up with the global big players, consumer acceptance and supply side bottlenecks have made complete electrification of vehicles seemingly very difficult. Also, with as many as 21 crore of registered motor vehicles plying on the roads, 99 per cent of which is powered by internal combustion engines, a major concern is the scrappage of the ICEs in the phase of electrification. While the production of vehicles based on internal combustion engine powertrain is ongoing, the projected additions to the stock also necessitates an

HyPixi – Hybrid Retrofit Kit by Altigreen Propulsion Labs

While a couple of such kits have been developed, one of the most widely accepted and accredited is HyPixi. HyPixi is pocket-friendly hybrid retrofit kit developed by Altigreen Propulsion Labs, a Bengaluru based start-up. Utilising a torque assisted regenerative electric system, HyPixi offers its users 25 per cent improvement in mileage and a substantial reduction in tailpipe emissions. Its advanced regenerative braking system helps to conserve energy thereby reducing fuel costs considerably. Distinguished for being the only retrofit kit which is AIS-123 compliant, HyPixi kit can be installed in less than four hours by two technicians under USD1200. Suitable for vehicles with gross weight under 2 tonnes, it has wide adaptability and may even be fitted into two, three and four wheeler vehicles. With five awarded global patents and large fleet operators in e-commerce, employee transportation, car rental and taxi cabs already as early customers, HyPixi aims at a sales target of 1 million vehicles in five years reducing carbon dioxide emissions by 2 million tonnes every year.

Source: Altigreen Propulsion Labs

4. Govt of india approves use of aftermaket hybrid electric kits for old cars, Overdrive, Published on 15 July 2016; This start-up has a low-cost solution to convert diesel cars into hybrid, ET Auto, J Srikant, Accessed on 29 July 2016

economical solution over complete and sudden movement to EVs.

Hybrid kits usually cost between INR 70,000 to 90,000, excluding government subsidies. At an individual level, the capital costs for their installation are essentially recovered in roughly 20,000 kms, given the fuel savings of nearly a quarter.

The savings for large fleet owners such as taxi services and last mile goods distributers are even larger since they mostly operate in heavy traffic conditions where the idling periods are more and internal combustion engines are inefficient. Besides, these kits mostly do not require any modifications to the original OEM engine, keeping the driving experience intact. Additionally, hybrids reduce the need for refuelling, saving time. While the gains for an individual are considerable, accompanied by a reduction by nearly 20 per cent in carbon dioxide emissions, making hybrid retrofits the ideal technology for transition into a 100 per cent electric mobility regime.

Powered by both gasoline and electricity, retrofitted vehicles burn less fuel than pure ICE vehicles. The U.S. Department of Energy estimates that for a 100-mile trip, a hybrid electric car produces 57 pounds of carbon dioxide compared to 87 pounds of carbon dioxide for a similar conventional vehicle.[5] A hybrid car produces 25-35 per cent less CO_2 emissions than conventional vehicles because it is has a second electric, battery powered engine, which recharges via the petrol/diesel engine.[6]

The Central Pollution Control Board (CPCB), India conducted Air Quality Monitoring and Emission Source Apportionment Study for Pune (2010)[7] in which a hybrid vehicle option has been recommended for passenger cars to reduce vehicular pollution.

One of the main benefits of retrofitted vehicles is reduced overall tailpipe emissions. Because less gasoline is used per mile, HEVs emit less particulate matters (PM), nitrogen oxides (NO_x), and carbon dioxide (CO_2) than conventional cars. Reduced tailpipe emissions have also been linked to a decrease in the rate of respiratory illnesses, including bronchitis, emphysema, pulmonary fibrosis, and asthma.[8]

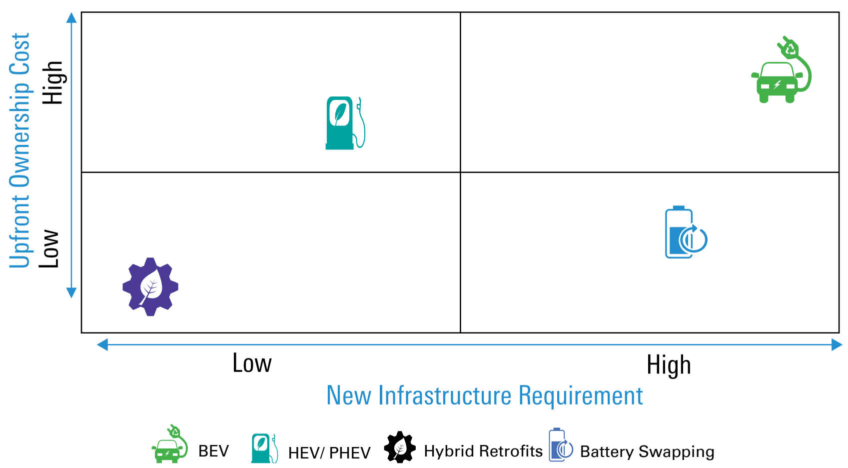
In June 2016, the government launched a pilot programme to run two-wheelers on Compressed Natural Gas (CNG)[9] as an attempt to curb pollution. Under the programme, 50 two-wheelers were retrofitted with CNG kits of which 10 were flagged off at the launch of the programme. Offering a mileage of 120km in a single fill, the retrofitted vehicles are estimated to emit 75 per cent lesser hydrocarbons and 20 per cent lesser carbon monoxide when compared to their petrol versions.

More recently, the National Capital Territory/city of Delhi in India lifted the ban it had imposed on sale of CNG kits after digitising the entire process from sale to purchase, avoiding the possibility of sales of any spurious kits. Also, early this year, Telangana State Road Transport Corporation decided to retrofit 30 buses from its existing fleet with CNG kits in an attempt to reduce its carbon footprint. A similar move was introduced by Bangalore Metropolitan Transport Corporation in December 2017. 150 buses due to be scrapped in 2015 are being converted into electric ones.

4.4: Summary note

Clearly, migration towards pure electric vehicle based mobility involves high cost and has high amount infrastructure requirement which needs more time. Plug-in hybrids and hybrid electric vehicles have low infrastructure requirements but the costs involved are high and price parity becomes a concern. Another widely considered option, battery swapping is a low cost one, but failing to fall in the evolution path of technology it is not a sustainable choice of mobility. Understandably, till BEV glides to Quadrant 1 of the given analysis, hybrid retrofits provide an ideal option which combine the benefits of lower infrastructure requirement with low tailpipe emissions, hence lesser cost, mitigating the negative impacts of ICEs and bridging the gap on the path of full electric mobility.

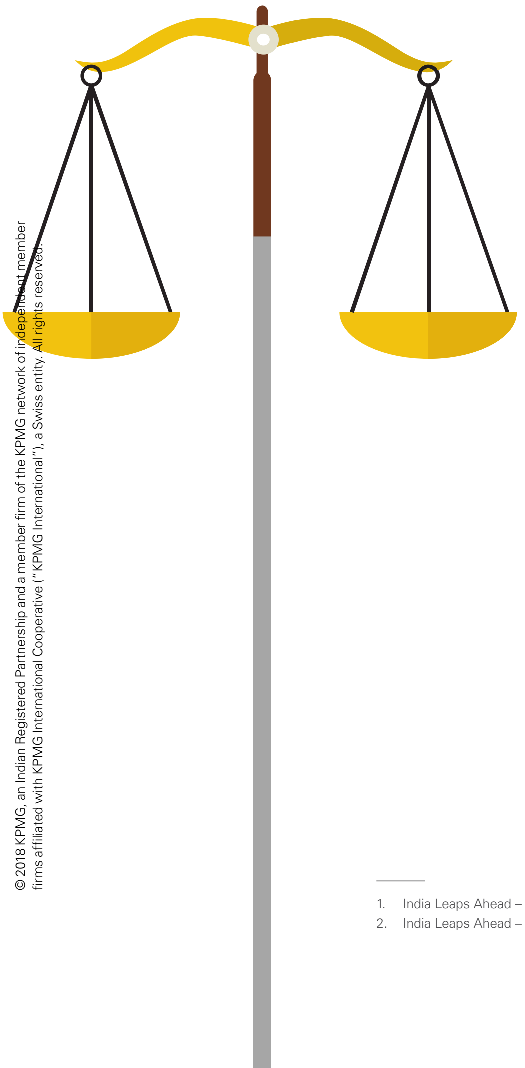
Figure 4: Mobility Ecosystem



5. Alternative Fuels Data Center, US Department of Energy, Accessed on 10 November 2017
6. Hybrid Vehicles-Advantages and Disadvantages, Prevent Climate Change, Kelly Fenn, Accessed on 6 March 2017
7. Air Quality Monitoring and Emission Source Apportionment Study for Pune, CPCB, Accessed on 8 March 2018
8. Hybrid (Gasoline and Electric) Vehicles, Government of Massachusetts, Accessed on 8 March 2018
9. Centre launches pilot to run two wheelers on CNG, Indian Express, Accessed on 6 March 2018

5

Potential Policy and Regulatory Measures



1. Policy to encourage retrofit hybrids for rapid transition to cleaner vehicles

The Government of India is moving towards the direct transition from ICE-powered engines to EVs. However, the ultimate goal is to shift to fuel efficient transportation that has less impact on the environment and health and reduced dependency on oil. As discussed in this report, there are many challenges involved in the direct transition to EVs from ICE. One of the main challenge is the lack of charging infrastructure. Since, hybrid vehicles are less dependent on charging infrastructure, the transition to hybrid could play a crucial role by bridging between ICE vehicles and EVs. Existing ICE-powered vehicles need to be incentivised to shift to hybrids using available technologies such as hybrid-retrofits, so that the journey to a cleaner future begins right now with the available, ready to use technology.

2. Tax benefits

As per the NITI Aayog report 'India Leaps Ahead'[1], May 2017, it has suggested, reducing the interest rates, indirect taxes and registration taxes at state level. In order to increase the number of EVs or hybrid vehicles on road, tax benefits could play a significant role. There needs to be zero registration fees for both EVs and hybrids. Also, EV and hybrid vehicles should be exempted from GST, till the time the target of complete electric mobility is achieved.

3. Demand Push at the state level

Demand push from the state government could play a crucial role in rapid adoption of EV/hybrid vehicles. Many state governments such as Telangana, Maharashtra and Karnataka are moving towards the adoption of electric vehicles in their policy. Several incentives could be considered to create a demand for EVs such as: Preferred/Free Parking at Municipalities/Private Parking/Airports, etc., Exemption or reduction of toll taxes and road taxes for commercial electric/hybrid vehicles. The vehicles should be certified by the government and should have a green number plate. Also, EV trucks should be exempted from the interstate time restrictions.

4. Incentives/subsidies for retrofit EV/Hybrids in the policy

FAME-2 is being implemented at present and subsidies are being provided by the government on purchase of EVs. Since the demand of EVs is also at a nascent stage, the Government of India can afford to provide subsidies to the end-consumer. However, continuous support to end users in form of subsidies is untenable in the long run as demand picks up. NITI Aayog has suggested a fee - rebate model where efficient vehicles are rewarded with rebates through a surcharge on inefficient vehicles.[2]

The Government of India could develop a policy to provide a subsidy to vehicle owners as an incentive for the conversion of petrol/diesel vehicles with more fuel efficient

1. India Leaps Ahead – Transformative Mobility Solutions for All, NITI Aayog, Accessed on 8 March 2018
2. India Leaps Ahead – Transformative Mobility Solutions for All, NITI Aayog, Accessed on 5 March 2018

vehicles such as hybrids. Different incentives could be provided on the basis of the type of vehicle (cars, vans, buses, trucks, etc.). Japan's 'Vehicle Replacement Scheme' is a successful initiative by the Government of Japan to increase the number of hybrid cars on road, could be taken as a reference study.

5. Investing in Research and Development

As per the report by NITI Aayog 'India Energy Storage Mission'[3] by investing in research and development of new and advanced battery technology, India can build a sustainable battery manufacturing supply chain. As per the report, cheap batteries, made in India, can not only support the government's goals for vehicle electrification, renewable energy integration and job growth, but also speed up the world's transition to a clean energy economy[4] Research and development would also lead to innovation and improvements. For example: Some companies have found a way to reduce the amount of key rare earth metal used in magnets for EV motors by around 20 per cent, which could help in lowering the EV production cost and reduce the risk of shortage of rare earth metals.[5] Also, some companies are moving towards accumulating cobalt for battery manufacturing.[6]

6. Global Collaborative Campaign in India

This global collaborative campaign in India is likely to bring together all the major stakeholders in electric and hybrid vehicles related industry which could be automobile, technology, energy, etc. and consumers to promote the use of both electric and hybrid vehicles. It could help the vehicle owners/buyers to understand the benefits of hybrid vehicles and their contribution to healthy environment and health. One of the successful examples of mass collaborative campaign is the 'Go Ultra Low' campaign in the U.K.

7. Public Procurement of electric and hybrid vehicles

The Government of India could mandate the public procurement of hybrid vehicles in all the states in India for government staff to promote the benefits and visibility of electric and hybrid cars on the road.

8. Temporary ban on petrol/diesel vehicles during air pollution crises

During emergency situations, where air pollution reaches alarming levels such as: alarming air pollution levels in Delhi during November 2016 and 2017, the state government could impose the temporary ban on petrol/diesel vehicles with 24 hours prior notice. Eco-friendly vehicles such as electric/hybrid/CNG vehicles could be exempted from the temporary ban.

Consumers could then realise the benefits of hybrid/electric vehicles to both health and environment. One of the successful examples is the temporary diesel cars ban in London and Oxford (U.K.), which was launched to mitigate the rising air pollution levels in the city.[7]

9. CSR activity for corporate organisations for influencing or incentivising employees for buying EV/Hybrid vehicles as a 'Go Green' initiative

As per the Company Act 2013, companies having net worth of INR500 crore or more, or turnover of INR1000 crore or more, or a net profit of INR5 crore or more during any financial year shall contribute at least two per cent of the average net profits of the company made during the immediately preceding financial year to Corporate Social Responsibility (CSR). As per CSR activities defined in Schedule 7 of the Companies Act 2013 'Ensuring environmental sustainability, ecological balance, protection of flora and fauna, animal welfare, agroforestry, conservation of natural resources and maintaining quality of soil, air and water including contribution to the Clean Ganga Fund setup by the Central Government for rejuvenation of river Ganga"[8], companies could contribute to the transition to EV/Hybrid vehicles and help in ensuring environment sustainability.

3. India's Energy Storage Mission Report, Niti Aayog, Government of India, Published on 18 November 2017
4. India's Energy Storage Mission, NITI Aayog. Government of India, Published on 18 November 2017
5. New Toyota magnet cuts dependence on key rare earth metal for EV motors, Reuters, Published on 20 February, 2018
6. Apple to Accumulate Cobalt for Battery Manufacturing Applications, FutureCar, Michael Cheng, Published on 28 February, 2018
7. Paris to ban all petrol and diesel cars by 2030 And Oxford aims to become world's first 'zero-emission zone' by end of this decade, The Week, Published on 12 October 2017
8. The Companies Act 2013, Ministry of Corporate Affairs, Government of India

Acknowledgement

This report has been developed under the guidance of

Dr. Jaijit Bhattacharya
Sidharth Tewari

The team for this report:

Aashish Suneja
Ankur Gupta
Harleen Batra

Markets and Compliance team

Anupriya Rajput
Rahil Uppal
Sharon D'silva

KPMG in India contacts:

Mritunjay Kapur
National Head
Markets and Strategy
Head - Technology Media & Telecom
T: +91 124 307 4797
E: mritunjay@kpmg.com

KPMG in India
25 YEARS
of making a difference

Follow us on:
kpmg.com/in/socialmedia