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# ENERGY



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# FUTURE

## COVER STORY

**Electric Vehicles: Scope and Challenges**



## FEATURE

**In-EV-itable Adoption of Electric Vehicles: The Road Ahead**

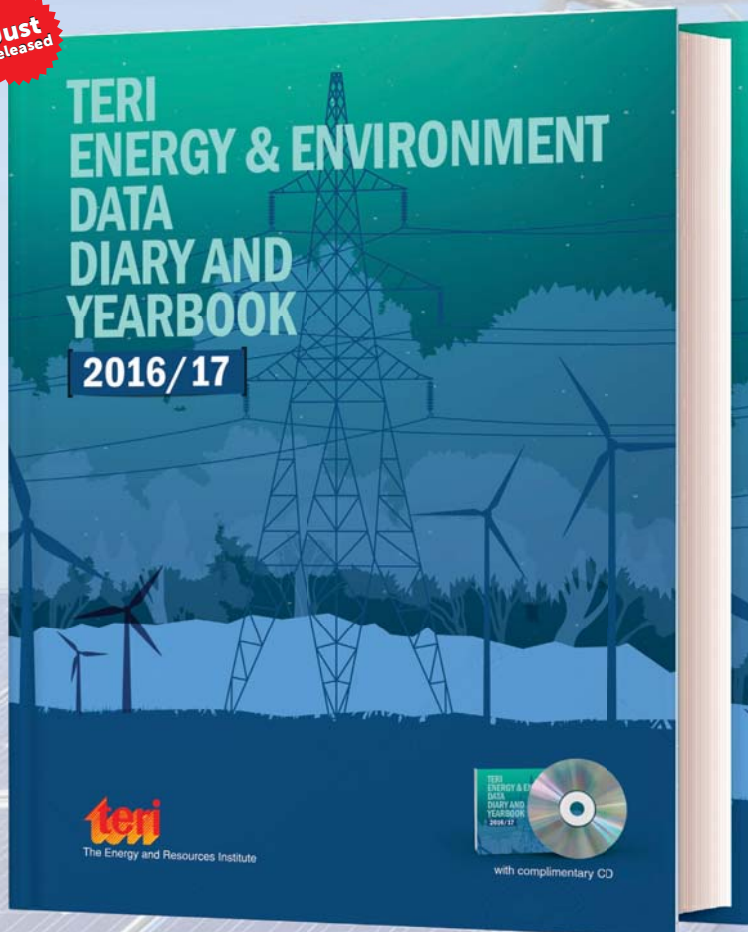
## VIEWPOINT

**Take Care of The Common Man; The Country Will Take Care of Itself**



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## From the editor's desk...

Since the advent of climate change debate, the focus has predominantly been on mitigation in energy generation. Relatively speaking, transportation is one sector that was relegated to the background—except in the context of biofuels—till recently. However, considering that transportation is responsible for approximately 23% of total energy-related carbon dioxide (CO<sub>2</sub>) emissions, it certainly deserves much greater attention. Indeed, the Intergovernmental Panel on Climate Change (IPCC) report states that *'Reducing global transport greenhouse gas (GHG) emissions will be challenging since the continuing growth in passenger and freight activity could outweigh all mitigation measures unless transport emissions can be strongly decoupled from GDP growth'*. But it is also a fact that as compared to electricity generation or other industrial processes, transport sector is way too complicated, especially since it actively interfaces with the user and her comforts. In this case, therefore, besides technology and policy push, behavioural aspects become equally important. This means creating enabling mechanisms, including intensive sensitization to change behaviour of consumers and businesses to make right choices. Adoption of non-motorized as well as mass-transit as preferred options falls in this category. New age business models like ride-sharing too are steps in this direction.

Technological innovations in green transportation cover a wide spectrum: from fuels to the vehicles themselves. Biofuels, hydrogen, and electricity are some of the options as far as clean fuels are concerned, provided of course that electricity and hydrogen are generated in a manner that is environmentally benign. But there is also a lot of focus on the design of vehicles—whether personal or commercial—through better aerodynamics and engine efficiencies resulting in lower emission levels. But in addition to these, there are other ways to minimize transport-related environmental impacts that too merit equal attention. For instance, how the traffic is managed in a city has a huge bearing on emission levels. Traffic jams, frequent stopping of vehicles, and excessive idling of engines all contribute to this conundrum. Fortunately, all of these elements—whether pertaining to behaviour or technology or regulation or management—are not mutually exclusive and hence can be pursued simultaneously.

Ultimately, all of the above will have to be attempted in the right earnest if SDG 11; particularly SDG 11.2 *'By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all'* and SDG 11.6 *'By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality'* are to be achieved in a timely manner. It is evident that energy future is closely linked with sustainable transportation!

Amit Kumar

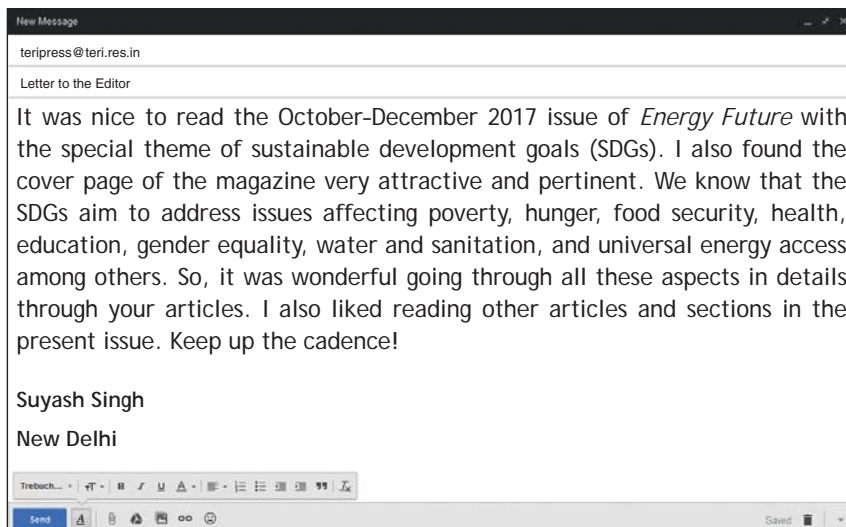
**Amit Kumar**

Senior Director, Social Transformation, TERI

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“ I got an opportunity to go through the last issue of *Energy Future* magazine at a colleague's office recently. I thought that I must laud your editorial and design team in bringing out this high quality publication on energy sector. Although from medicine background, I have an abiding interest in the energy sector and the latest happenings in this arena. I quite agree with the viewpoint of Dr Anjan Ray, Director-C-SIR-Indian Institute of Petroleum, that the Government of India is taking concrete steps to promote biofuels. An important part of this is to raise awareness across the country and to encourage entrepreneurs and investors to see the future value of participation in this growing sector.

Dr Anirudh M Gokhale  
Pune, Maharashtra

Thank you very much for your encouragement. The editorial team of *Energy Future* will ensure that the magazine caters to your information and knowledge needs. We welcome your suggestions and comments to further improve our content and presentation.

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**Editor**  
Energy Future

“ It was a delight to read the October–December 2017 issue of *Energy Future* with all the latest news, articles, and events related to the energy segment. The article 'CSP Technology in India' published in the Solar Quarterly section is an important one indeed. CSP or concentrated solar power must be developed in India as there are price fluctuations in fossil fuels, such as coal and gas. Seeing the potential of CSP in India, it becomes necessary to develop local manufacturing of mirrors, storage materials, etc., locally. This would certainly reduce the capital cost along with the operations cost. We all hope that apart from cost reduction, it will create jobs and make India's CSP market more reliable.

Ragini Mehrotra  
Chandigarh

“ With reference to the feature article 'Energy and Environmental Challenges' published in the latest issue of *Energy Future*, I would like to say that energy is the crucial currency of the modern era. An unquestionable requirement of a growing economy such as India, energy is the essence of manufacturing, transport, construction, communication, and mobility. The post-industrial revolution demand for fossil fuels has strained our planet's ecological health. The damage caused by burning the vast quantities of carbon-based fuels needed to run our development engines and modern economies is well known now. We are looking at increasing atmospheric temperatures, melting glaciers, rising sea levels, changing rainfall patterns, failing agriculture, drought, floods, and rampaging rivers. Apart from this, the health detriments, deteriorating quality of life, and economic costs of pollution from fossil fuels are also well known to everybody. I hope good sense prevails for the betterment of our planet.

Pankaj Chattopadhyay  
Ranchi, Jharkhand



# CONTENTS



## 4 NEWS

### COVER STORY

- 12 Electric Vehicles: Scope and Challenges

### FEATURES

- 20 Electric Vehicles: Is India Ready for the Big Transition?  
28 Riding the Green Wave  
36 In-EV-itable Adoption of Electric Vehicles: The Road Ahead

### ENERGY INSIGHTS

- 42 Ionic Liquids: Significance in Renewable Energy Production

### THE SOLAR QUARTERLY

- 48 Modelling, Simulation, and Performance Analysis of Monocrystalline and Polycrystalline Panels

### SPECIAL EVENTS

- 52 9th GRIHA Summit 2017  
54 INTERSOLAR INDIA

### VIEWPOINT

- 56 Take Care of The Common Man; The Country Will Take Care of Itself

### 64 ABSTRACTS

### 66 PRODUCT UPDATE

### 68 BOOK ALERT

### 70 TECHNICAL CORNER

### 74 INDUSTRY REGISTRY

### 75 EVENTS

### 76 RE STATISTICS

## GOVERNMENT TO PROMOTE METHANOL AS ALTERNATIVE FUEL TO REDUCE INDIA'S OIL IMPORT BILL

In a bid to lower crude oil import bill, the Government of India will promote coal gasification to convert high ash coal into methanol that can be used as cooking gas and transportation fuels, according to NITI Aayog member V K Saraswat. He also said that methanol is a good substitute for transportation fuels and cooking fuel and there is merit in India also looking at methanol economy. He further added that "We can reduce high crude oil import bill, which is pegged at ₹6 lakh crore per annum by producing methanol from high ash coal. Methanol gas is always cheap, safe and pollution free," he said. The usage of methanol fuel-powered boats in inland waterways has also been proposed. **EF**



Source: LiveMint

## YES BANK, EIB TO CO-FINANCE \$400 MN FOR CLEAN POWER PROJECTS

YES Bank and the European Investment Bank (EIB) will co-finance \$400-million funding for renewable power generation in the country. "The new financing programme will streamline financing for a range of renewable energy projects being built and operated by leading

Indian corporations and private sector developers," according to the YES Bank and EIB joint statement.

Of the \$400-million, the EIB will fund \$200 million, while the rest will be supported by YES Bank, the project promoters, and other financial institutions. Under this renewable



power generation initiative, several solar projects in Rajasthan, Maharashtra, and Karnataka have been identified. Additional wind and solar projects are also being examined. The EIB loan of \$200 million has a tenure of 15 years. **EF**

Source: The Hindu Business Line

## INDIA'S WIND ENERGY GENERATION UP 35% IN Q3 2017

Good monsoon winds and a sharp jump in installed capacity helped India generate record wind energy in the July–September 2017 quarter. According to data released by the Indian government, wind energy generation in the country jumped 35% in Q2 2017 compared to the preceding quarter. This increase was likely the result of high wind speed thanks to a good monsoon season this year and the result of a 14% increase in installed capacity between October 2016 and September 2017. **EF**



Source: Clean Technica

# MYTRAH ENERGY ERECTS INDIA'S TALLEST MET MAST

Renewable energy independent power producer Mytrah Energy has erected and commissioned the tallest met mast of 160 m height in the Asia Pacific region on November 16 at Kayathar in the Tuticorin belt in Tamil Nadu.

"Power output depends on the size and height of turbines. Larger wind turbines lead to cost-effective power generation. Mytrah's commissioning of this met mast reflects its focus on developing technological tools for revolutionizing the renewable energy sector in the country," said Vikram Kailas, Vice Chairman and MD, Mytrah Energy (India) Pvt. Ltd (MEIPL).

The met mast has five wind speed monitoring levels (160 m, 140 m, 120 m, 90 m, 50 m), three wind direction monitoring levels (138 m, 118 m and 88



m), two temperature monitoring levels (160 m and 10 m) and one pressure sensor level (10 m). It is a combination of 400 mm x 400 mm and 300 mm x 300 mm square lattice structure with L

angle tube that has all the sensors placed according to the IEC 61400-12-1 standard for accurate measurement of wind speed and direction. **EF**

Source: The Hindu Business Line

## LED LIGHTS TO ILLUMINATE ALL SCR STATIONS BY MARCH 2018

All 704 railway stations under the jurisdiction of the South Central Railway (SCR) will be 100% illuminated with LED lights by March 2018, according to General Manager Vinod Kumar Yadav. The zone has been at the forefront in initiating energy conservation measures on traction, non-traction and diesel wings. It has also pioneered installation of energy efficient gadgets such as LED lighting, brushless DC electric motor saving fans, inverter type ACs, and so on, with special focus on generating power from renewable resources, such as solar, wind, and day light pipe technology. Guntakal is the first division on Indian Railways to complete 100% LED lighting of all 157 railways stations under its jurisdiction. **EF**

Source: The Hindu





# TATA POWER RENEWABLE ENERGY LTD COMMISSIONS 100 MW SOLAR PLANT IN KARNATAKA

India's largest renewable energy company and TATA Power's wholly-owned subsidiary, TATA Power Renewable Energy Ltd (TPREL) has commissioned a 100 MW solar plant (50MW X 2) at Pavagada Solar Park in Karnataka. The project was won by the company in May 2016 under the National Solar Mission Phase-II Batch-II Tranche-I State Specific Bundling Scheme. According to Mr Rahul Shah, CEO, TPREL, "The commissioning of the 100 MW solar plant in Karnataka fortifies our position of being the largest renewable energy company in the country, with a strong presence in solar power generation. We prefer development opportunities in solar



parks as land and evacuation are provided, and we can focus on the project. We are extremely proud of this development and we continue to seek

potential areas across India and in select international markets through organic and inorganic opportunities." **EF**

Source: Equity Bulls

# REWA SOLAR TO BRING ₹3, 306 CR SAVING IN TARIFF AND POWER DMRC TRAINS

The Rewa Ultra Mega Solar (RUMS) park will save ₹2,086 crore for Madhya Pradesh government's power utilities and ₹1,220 crore for Delhi Metro over 25 years. The marquee project of the state government in February 2017 threw up record low tariff of ₹2.97 a unit (kilowatt/hour) during bidding. Mahindra Renewables, ACME Solar Holdings, and

Solengeri Power bagged the three units at ₹2.979, ₹2.97, and ₹2.974 tariff for the first year.

According to Madhya Pradesh Chief Minister, Shivraj Singh Chauhan, the 750 MW project busted the myth that solar power is expensive by achieving record low tariff of ₹2.97. Development

of large-scale solar power projects in the country has, so far, been the initiative of the Centre. The Rewa project has demonstrated that the states can stand alongside the Union government to fulfill this responsibility, he said. **EF**

Source: Business Standard





# GOVERNMENT STARTS SAFEGUARD DUTY PROBE ON SOLAR CELLS

India has started a probe to determine imposition of safeguard duty on surging imports of solar cells with a view to protect domestic manufacturers.

Domestic manufacturers have approached the Directorate General of Safeguards (DGS) with a complaint that their market share has remained stagnant despite rapid expansion in demand for solar cells in the country. India is targeting to 100 GW solar capacity by 2022. The current installed capacity is about 15 GW. The government has planned to auction 20 GW capacities by March 2018, and 30 GW each in next two fiscals.

Solar cells, electrical devices that convert sunlight directly into electricity, are imported primarily from China, Malaysia, Singapore, and Taiwan.

The application for imposition of the import restrictive duty has been filed by the Indian Solar Manufacturer's Association (ISMA) on behalf of five Indian producers—Mundra Solar PV, Indosolar, Jupiter Solar Power, Websol Energy Systems, and Helios Photo Voltaic. **EF**

Source: The Economic Times



# INDIAN OIL CORP OPENS INDIA'S FIRST ELECTRIC CHARGING STATION IN NAGPUR

In a major step in spreading the use of green energy, India's first electric vehicle (EV) charging station was started by Indian Oil, according to the state-run oil marketing company. Indian Oil has partnered with cab aggregator Ola to set up the charging station at an IOC petrol pump in Nagpur. "Nagpur, being the first city to introduce the electric public transportation model in India, has added one more feather to its cap by adding the first electric charging station at Indian Oil's COCO (company-owned, company-operated) fuel station in the city," an IOC release said.

In its annual report for 2016/17 presented earlier this year, IOC said it planned to set up battery charging stations and was exploring the manufacture and retailing of lithium-ion batteries.

The governments' National Electric Mobility Mission Plan launched in 2013



aims at gradually ensuring a vehicle population of about 6–7 million electric and hybrid vehicles in India by 2020. The

vision enunciated two years ago is for India to have 100% EVs by 2030. **EF**

Source: The Economic Times

# WORLD BANK PUTS FOSSIL FUELS ON NOTICE

The World Bank Group (WBG) during the One Planet Summit in Paris said that, as of 2019, it will no longer finance exploration for and production of oil and gas.

The One Planet Summit, which was organized by the United Nations and WBG, brought together local, regional, and national leaders from around the world, along with public and private finance entities to identify ways to accelerate global efforts to fight climate change.

WBG said that it will make exceptions in its stance on gas financing in the poorest countries where it benefits energy access for the poor.

In addition, WBG said that it will present a “stock-take” of its Climate



Change Action Plan, which includes targeting 28% of its lending for climate action by 2020, and announce new

commitments and targets for 2020 at COP24 in Poland next year. **EF**

*Source: renewableenergyworld.com*

# CHINA THREE GORGES STARTS WORLD'S BIGGEST FLOATING SOLAR PROJECT

A unit of China Three Gorges Corp. is building a 1 billion yuan (\$151 million) floating solar power plant, the world's biggest, in the nation's eastern province of Anhui.

China Three Gorges New Energy Co. started building the 150 MW project in July and part of the plant has connected to the grid. The project features panels

fixed to floats on the surface of a lake that formed after a coal mine collapsed, according to the unit. The entire facility is expected to come online by May 2018.

Floating solar is getting bigger in China, where ground-mounted projects are not used to full capacity because of grid congestion. About 5.6% of solar power generation was idled in the first

three quarters, according to data from the National Energy Administration.

Before construction of China Three Gorges' plant, China's biggest commissioned floating solar project was a 40 MW farm by Sungrow Power Supply Co. in the same province, according to Bloomberg New Energy Finance. **EF**

*Source: renewableenergyworld.com*



# ADB FUNDS RENEWABLE ENERGY PROJECT IN MARSHALL ISLANDS

The Asian Development Bank (ADB) is to provide a US\$ 2 million grant to help the Marshall Islands increase its renewable electricity generation.

The agreement for the grant, which is aimed at reducing the Marshalls' consumption of fossil fuels, was signed by its President Hilda Heine in the capital Majuro.

According to the ADB, the Majuro Power Network Strengthening Project will support the country's renewable energy goal of achieving 20% renewable electricity generation by 2020.

Currently, diesel generation accounts for about 98% of annual power generation in Majuro.

Similar projects are being funded by the ADB in the Cook Islands, the Federated States of Micronesia, Kiribati, Nauru, Palau, Samoa, Solomon Islands, Tonga, Tuvalu, and Vanuatu. **EF**

Source: [www.radionz.co.nz/Radio New Zealand](http://www.radionz.co.nz/Radio New Zealand)



# NEW BIOGAS PLANT IN BELARUS IS OPERATIONAL

The first biogas plant under a framework agreement between the government of Belarus and the European Bank for Reconstruction and Development (EBRD) has started operation in the city of Baranovichi in western Belarus. The EBRD provided a €2.9 million (\$3.5 million) sovereign loan

for the construction of the facility which will generate 4,380 MWh of electricity and 3,880 Gcal of heat per year from biogas extracted from wastewater sludge.

The Swedish International Development Cooperation Agency (Sida) invested additional funds

for capital expenditure and project implementation consultancy work.

The biogas power plant is expected to achieve energy and cost savings, reduce greenhouse gas emissions and the volume of sludge, and improve the quality of services. **EF**

Source: [www.renewableenergymagazine.com](http://www.renewableenergymagazine.com)





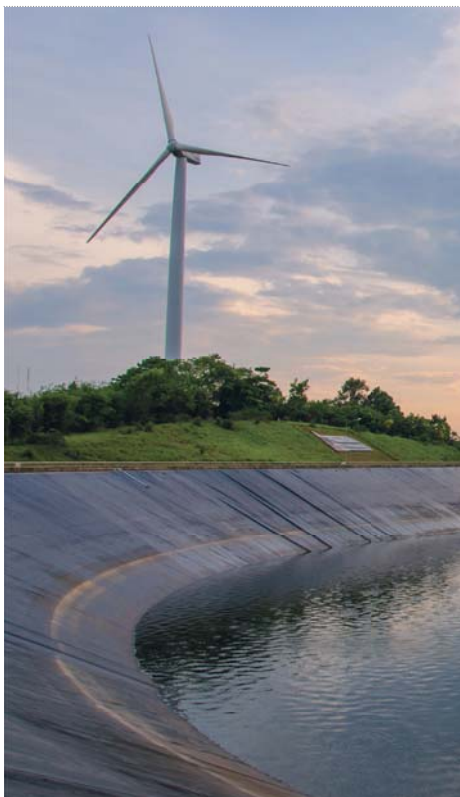
# IRAQ REACHES INITIAL DEAL WITH CHINA'S ZHENHUA TO DEVELOP EAST BAGHDAD OILFIELD

Iraq has reached an initial deal with China's state-run Zhenhua Oil to develop the southern portion of the East Baghdad oilfield, according to the oil ministry spokesman. Iraq is seeking the help of Zhenhua Oil to increase production from East Baghdad oilfield to 40,000 barrels per day within five years of the start of the development operations.

Iraqi oil officials have estimated the East Baghdad field, a "super giant" with around 8 billion barrels of crude reserves, has the potential to produce 120,000 barrels of oil per day. Oil Ministry officials said increasing East Baghdad crude production would help feed nearby refineries and power stations and free up more oil for exports from the southern region. Iraq produces and exports the bulk of its crude from the southern region. **EF**



Source: Reuters



## EIB BACKS RENEWABLE INVESTMENT IN GREECE, INCLUDING HYDRO

The European Investment Bank (EIB) has approved a €35 million loan that will support the refurbishment of existing small hydropower and wind projects, as well as the construction of new projects across Greece. The funding will back a new investment programme by PPC Renewables across mainland Greece and the Greek Islands and will finance a pipeline of 18 renewable energy projects. It represents the largest

ever support for renewable energy investment in the country by the EIB.

Once complete the schemes, together with planned wind investments, will increase generation of renewable energy in Greece by 90MW and make a significant contribution to both national and European renewable energy objectives. **EF**

Source: Water Power Magazine

# DUTCH GOVERNMENT CONFIRMS ZERO-SUBSIDY WIND FARM WILL GO AHEAD

The Dutch government's decision to hold the first zero-subsidy auction for offshore wind has paid off, with the government announcing that bidders have come forward and the site will be developed without state support. The Swedish utility Vattenfall revealed it had put in an offer to the auction, which is seeking to find developers for 700 MW of offshore wind capacity off the Netherlands' southwest coast. This was followed by confirmation from the Dutch government that the Hollandse Kust (zuid) Wind Farm Sites I and II will be built without any subsidy, after the auction closed to bidders yesterday.

Auction winners will be chosen over the next few months, with a view to getting the wind farm up and running by 2022, supplying one million households with clean electricity. The



winner will receive a permit to develop the site, but no state subsidy.

The Dutch authorities changed the rules of the auction after renewable

developers offered to build offshore wind farms at market prices in Germany earlier this year. **EF**

Source: Business Green

## CHINA DECEMBER FACTORY GROWTH EASES AS TOUGH POLLUTION MEASURES BITE

Growth in China's manufacturing sector slowed slightly in December 2017 as a punishing crackdown on air pollution and a cooling property market start to weigh on the world's second-largest economy. The data support the view that the economy is beginning to gradually lose steam after growing by a forecast-beating 6.9% in the first nine months of the year, but the findings did not appear to suggest a risk of sharper slowdown at this point. The figures showed that China's full-year 2017 economic growth would be at about 6.9% and around 6.5% for 2018, according to the China Federation of Logistics and Purchasing, which compiles the data.

China's leaders are counting on growth in services and consumption to rebalance their economic growth model from its heavy reliance on investment and exports. **EF**

Source: Reuters





# ELECTRIC VEHICLES

Scope and Challenges





In the present day, urban transport planning in India addresses numerous challenges, such as the steadily deteriorating air quality, rising greenhouse gas emissions, and adverse rising energy security risks. In order to mitigate these adverse effects, greater number of measures, beyond the policies already in place, will be required. In this context, electric vehicles offer alternate mobility options in order to redress the adverse impacts. **Professor G Anu Kumar**, through this article, presents the present EV landscape in the country and the challenges en route.



## Introduction

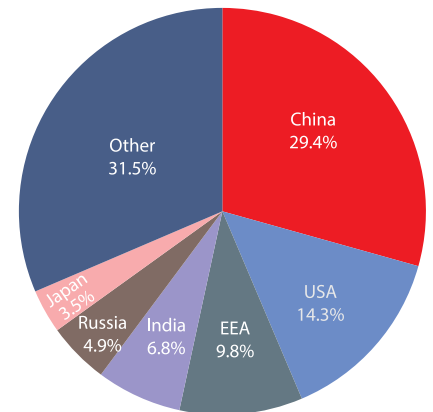
The idea of greater usage and adoption of electric vehicles (EVs)/green mobility, besides being futuristic, presents an impactful and constructive opportunity for India. As per the national auto policy, green mobility refers to all those mobility options that emit lower emissions—in terms carbon dioxide (CO<sub>2</sub>) g/km than pure internal combustion engine vehicles—through the use of alternate fuels, drive-train technologies or other measures. The motivation to adopt sustainable mobility solutions lies in reducing greenhouse gas (GHG) emissions and the dependency on imported energy sources as well as mitigating the adverse impacts from transportation. Interventions in this context exist towards ensuring a more sustainable and climate compatible Indian transport growth, such that development and climate change agendas are accommodated. Even certain developed countries, such as Britain, plan to ban the sale of conventional vehicles only by 2040.

## The Paris Climate Agreement 2015 (under UNFCCC)

The urgency of faster adoption of electric vehicles derives its motivation from the climate crisis. And the global climate crisis mitigation strategy made good progress after the Paris Climate Agreement in 2015 wherein it was

decided to keep the temperature rise below 2 °C above pre-industrial levels. In this context, an understanding of the relevant pointers with reference to the Paris Climate Agreement 2015, under the United Nations Framework Convention on Climate Change (UNFCCC), is listed as follows:

- » India, at present, is the world's third largest emitter of GHGs.
- » Based on the commitment made in 2015, ahead of the UNFCCC Paris Climate Summit, India has committed to target 40% of its electricity from non-fossil fuel based energy sources by 2030.
- » India has also committed to reduce its carbon emissions per unit of gross domestic product (GDP) growth by 33%–35% from its 2005 levels by 2030.
- » China has committed to reduce its carbon intensity by 60%–65% by 2030.
- » During the Summit, the Prime Minister of India, Shri Narendra Modi, voiced the genuine concern of developing nations when he conveyed that “A vast section of humanity lives at the edge of poverty and in darkness after the sun sets, they need energy to light up their homes and power their future”. He went on to state that for this, “The advanced countries must leave enough room for developing countries to grow”. This means that our emissions will continue to rise but at a slower pace which is why India chose to commit to an absolute cut in emissions instead of committing to a cut in carbon intensity.

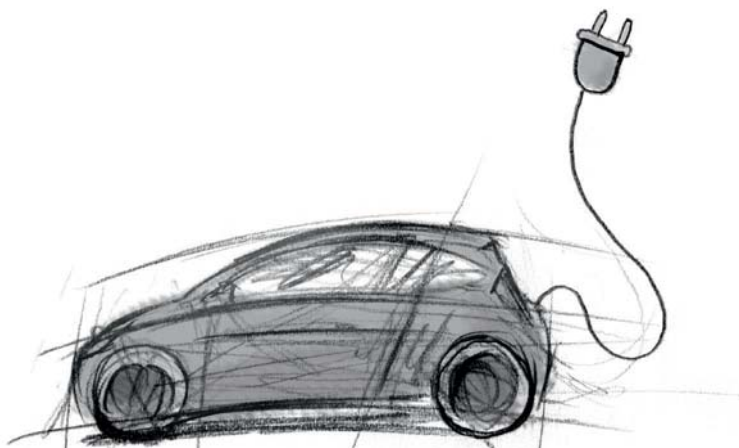


**Figure 1** Global carbon dioxide emissions by jurisdiction<sup>1</sup>

## Background

Nevertheless as a responsibility the Prime Minister said “And, we must strive for a lighter carbon footprint on our growth path.” India has approximately 42 motor vehicles per 1000 people,<sup>2</sup> compared to 797 motor vehicles per 1000 people in the United States.<sup>3</sup> This number is expected to increase rapidly as the economy develops.

- » The petroleum-based road transportation sector in India is responsible for a good share of the country's GHG emissions. Around 87% of India's carbon dioxide (CO<sub>2</sub>) equivalent emissions of the transport sector derive from road transport.
- » Moreover petroleum-based transportation, primarily in the form of diesel, in India is a major cause of air pollution.<sup>4</sup> Diesel exhaust contains pollutants that cause respiratory irritation, heart diseases, lung cancer, among other dangerous diseases, thus, causing substantial health risk to those who are frequently exposed to diesel exhaust.
- » The only way to address these issues is to migrate from existing conventional diesel vehicles to pure electric



1 [https://en.wikipedia.org/wiki/Paris\\_Agreement](https://en.wikipedia.org/wiki/Paris_Agreement)  
 2 “Road Transport Year Book 2014-15 category-wise total registered motor vehicles in India as on 31 March 2015”  
 3 Table 1-11, US Bureau of Transportation Statistics  
 4 <http://www.moef.nic.in/>



vehicles or at least plug-in hybrids. But then EVs and plug-in hybrid electric vehicles (PHEVs) are costlier than their conventional diesel counterparts.

- » Keeping these developments in view, the government of India launched the National Mission on Electrical Mobility (NMEM)<sup>5</sup> in 2011 and subsequently the National Electric Mobility Mission Plan 2020 in 2013 under the Ministry of Heavy Industries and Public Enterprises, Government of India, wherein eco-friendly vehicles were promoted and plans were underway to create a potential demand for 5 to 7 million EVs, including buses, light commercial vehicles, two-wheelers, and three-wheelers, as well as electric cars.<sup>6</sup>

<sup>5</sup> <http://dhi.nic.in/>

<sup>6</sup> National Mission on Electrical Mobility

## EVs: Opportunities & Challenges

As a prudent and attractive solution to vehicular pollution, particularly in urban areas, EVs help in reducing the levels of GHG emissions, local air pollution, and noise pollution primarily in cities. EVs would play a major role to help India meet her environmental commitments and thus, create a competitive market space for EV is the first task the government wishes to take up. For that, the government has to take measures to address the various concerns and challenges EVs face today such as high initial cost, low mileage, lack of charging infrastructure, lack of standards for mass deployment, lack of awareness of customer expectations in the Indian context, power quality, and power

congestion problems in the grid and so on.

- » **Reduced Air Pollution:** Air pollution in Indian cities is a major cause of concern in present times. In November 2017, Delhi had to close down 4,000 schools for almost a week, since the pollution levels reached nearly 30 times the World Health Organization (WHO) safe limits. According to estimates, more than 50% of children in Bengaluru suffer from asthma. The advent of EVs will drastically reduce air pollution in the metros.
- » **Reduced Noise Pollution:** Basic traffic noise is a permutation of noise emanating from engine, tyre, road surface, and wind passage. The national ambient noise monitoring programme (NANMP) of the Central Pollution Control Board (CPCB) and



its state counterparts reveal that the average noise pollution level in seven major Indian cities, exceeds the permissible limits, including in Delhi, Mumbai, Kolkata, and Chennai. In this context, EVs are silent hard workers of high efficiency and produce lesser noise on all parameters.

- » **Lower GHG Emissions:** Even though tailpipe emissions have reduced, the power for an EV continues to be generated in a remote thermal power plant. Thus, the true environmental benefit of EV will start emerging when renewables begin taking up a major share of power supply and replace the coal. The country has seen an increase in infrastructure of renewable energy resources, such as solar and wind, on account of improved competitiveness of renewable energy technologies.
- » **Identifying Customer Expectations:** The government plans to demonstrate and establish the economic and technical feasibility on Indian roads by introducing a pilot fleet of EVs for public transportation. A detailed survey of EV-specific customer expectations, envisaged to

estimate the expectations on range, mileage, investment cost, running cost, charging time, and payback, will provide greater clarity on the electric mobility plan in the Indian context. These are being explored in addition to the cost benefit potential of mass production and needs to consider the available technological possibilities (especially battery), Indian customer expectations, and also the future trends in fuel and electricity prices.

- » **High Initial Cost:** As on date, the high price of EVs, currently two to three times more than their equivalent conventional counterpart, is perhaps the most significant customer concern. Nevertheless, the operating cost of EVs can go as low as 1/4th of the conventional vehicle. Government subsidies and incentives shall go a long way in bridging this price gap. Simultaneously, exploring the feasibility of retrofitting existing conventional vehicles will also be undertaken.
- » **Less Mileage:** The possibilities of higher number of charging stations, faster charging rates, and opportunity

charging needs to be explored to address this concern. Based on the mileage of EVs, DC fast charging terminals need to be deployed at specific intervals. If these terminals are located near bus terminals, the passenger fleets can exploit opportunity charging.

- » **Lesser Number of Charging Stations:** The government needs to develop a strategy for creating a well-planned charging infrastructure to support the mobility of new EV fleets that shall charge the customer with a low cost per kWh and hence, enhance the customer's willingness to pay (WTP). The government will also look into possibilities of policy interventions, such as regulatory amendments to set up charging infrastructures in homes, offices, and public places. Amongst the various technological types of public charging stations (such as AC & DC chargers and technical variants within them), the ones suited in the Indian context needs to be selected and implemented. India has around 56,000 fuel charging stations, and





the government is keenly looking towards the possibility of using the petrol stations also as EV community charging stations. The change has already begun in November 2017 when Nagpur became the first city and Indian Oil Ltd the first oil company in India to set up an EV charging station at a petrol pump.

- » **Stringent Standards:** Since the deployment is envisaged on a large scale, besides charger standards, there is a need to develop standards for storage, monitoring, metering, control, and billing of energy transactions and also a communication standard to facilitate information transfer.
- » **More Power Congestion:** The extent of burden on the already congested power grid as a result of usage of EVs is yet another significant challenge being faced by the power engineering community at present. It is pertinent to note at this point that this power

grid has already witnessed two massive power blackouts in world history.

- » **V2G Transactions:** Nevertheless, in the midst of all the challenges, there lie various opportunities as well. The distributed PVs plugged into the grid can be considered as a massive storage reserve. If coordinated and harmonized by an independent system operator (ISO), this massive storage capacity can help bridge the supply–demand mismatch problem by feeding power from the vehicle battery back to the grid (V2G) during peak hours using the methodology of peak shaving and valley filling. Nissan Leaf & Toyota Prius are all set with their Leaf to Home and Vehicle to Load features.
- » **More Power Quality Problems:** As EVs start appearing more prominently on the roads, a relatively recent challenge of Power Quality (PQ) will

reemerge into importance. Thus, EVs are going to make a serious impact on power consumption, pattern of power consumption, and the power quality. In the near future, as battery technology becomes cheaper, fossil fuels become costlier, electric vehicle technology becomes cost effective, government incentivizes EVs, income generation opportunities emerge through V2G transactions, charging stations becomes widespread, and as GHG emission law more stringent, it is a natural expectation that EVs will become popular and economically viable.

## Key Developments

- » **FAME Initiative Phase 1:** Under the FAME 2015<sup>7</sup> initiative, this subsidy has become a reality. Customers purchasing EVs will earn a subsidy from the dealer/manufacture which

<sup>7</sup> <http://dhi.nic.in/UserView/index?mid=2418>



will be reimbursed by the government. However even after the subsidy, the cost difference between conventional diesel vehicles and electric vehicles continues to remain high. The sales figures of car manufacturers stand testament to this fact. Under FAME-1 programme, the government announced and implemented subsidies for Electric Vehicle purchases. As on January 1, 2017, 1,76,127 vehicles have benefited from the FAME Scheme resulting in a fuel saving of 208,94,262 litres (41,603 litres per day), and CO<sub>2</sub> reduction of 5370809 kg (1,04,063 kg per day).<sup>8</sup>

» **FAME Initiative Phase 2:** Under FAME-2 programme, the government intends to replace all government vehicles by EVs and will reach our roads this year (2018). The key objective of FAME-2 is to make the entire public transport in India 100% electric. It is planned to

be implemented on a pilot basis in 11 cities for buses, taxis, and auto rickshaws. These cities have been selected on the basis of their population, vehicle density, and vehicular pollution levels. EV buses are well suited for public transport in cities as they possess various features, such as zero local pollution, low noise and vibration, simplified centralized charging infrastructure (demand aggregation), and regenerative braking opportunity. These features would hopefully encourage the urbanites to prefer public transit over personal vehicles, thus reducing CO<sub>2</sub> per passenger mile.

» **Manufacturing Sector:** Even the manufacturing sector has started aligning their businesses with the vision of the government. Honda is looking forward to set up a Lithium-ion battery manufacturing plant in India. Maruti Suzuki is all set for a market survey to understand customer

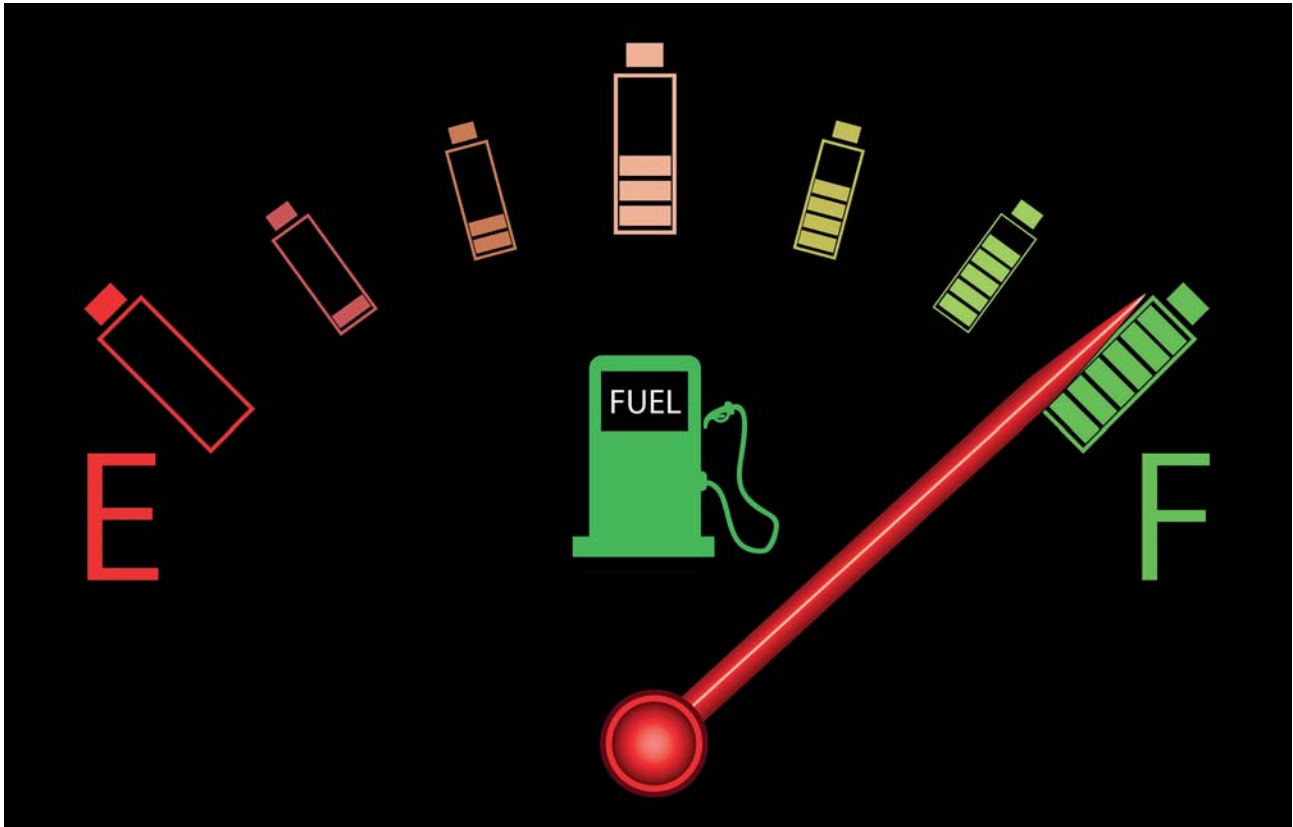
expectations. India is the world's third largest three wheeler market. The Karnataka government is planning to launch e-auto rickshaw in Bengaluru, whereas the Andhra Pradesh government has recently signed a memorandum of understanding with Toyota to work towards introduction of PHEVs and EVs for the ambitious smart city project at Amravati. Tata has won the tender for 10,000 EVs by Energy Efficiency Services Ltd (EESL). On the global front, Honda is partnering with Nissan for developing solid state battery technology. Tesla is planning to build electric pickup truck while BMW expects to achieve 500k EV sales by 2019.

## Yes, We Can

The impending global climate crisis demands quick action on all fronts. India, in the recent past has proved its administrative will and time bound dexterity in strategic planning and

<sup>8</sup> <http://www.fame-india.gov.in/>

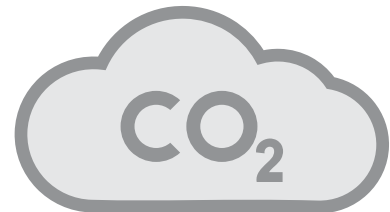




implementation on a massive scale, such as the UJALA & SLNP programmes to name a few. The UJALA programme, for instance till date, has distributed 28 crore LEDs insofar as strategic planning helped in overcoming the cost barrier. With the bold vision of 2030, the motivation of climate change mitigation, the ability/will of able proven administration, the future seems to be bright for the advent of EVs on Indian roads. In such a scenario, 12 years from now, there will, optimistically and realistically, be the dawn of a new clean, green, energy efficient, and quiet transportation system. Needless to say, the greatest beneficiaries will be the future generation, our children.

## Conclusion

As the US backs off from the Paris climate commitments, it will be interesting to see India's response to the impending global energy and climate crisis. The transformation, if meticulously planned and executed to perfection,



can bring back India to become the prosperous nation it once was. In order to achieve these ambitious goals, earnestness of purpose and the requisite dedication to work are essential.

Finally, to conclude, if India can send a satellite to Mars at ₹7 per km, that is less than the fare of an auto rickshaw and that too at a price ten times less than the US, using indigenous technology, we should definitely not underestimate her ability to convert the auto rickshaw into an electric auto rickshaw and that too at a lower cost. **EF**

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# ELECTRIC VEHICLES

## Is India Ready for the Big Transition?

In order to enable India's electric mobility opportunity, certain key challenges need to be addressed and a collaborative approach between India's public and private sectors is imperative. **Preeja Aravind**, through this article, debunks certain myths around e-mobility in India and the road ahead for a seamless transition to usage of electric vehicles.



## Context

"The Tata Nano is making a comeback with an electric motor under the hood." This has been heralded by the industry as good news and for reasons more than one. According to Bloomberg, the global electric vehicle industry grew by a whopping 63% in 2017. Exciting new launches around the world comprising products majorly from Tesla Motors are assuming centre stage in the automobile sector.

The steady depletion of fossil fuels and greenhouse emissions create major climatic changes and clearly electric vehicles (EVs) are the future of automobiles. Traditionally, oil lobbies have spent a tremendous amount of money to disprove the effectiveness of EVs and their impact on the environment. The new wave of EVs and all the innovation within the sector are

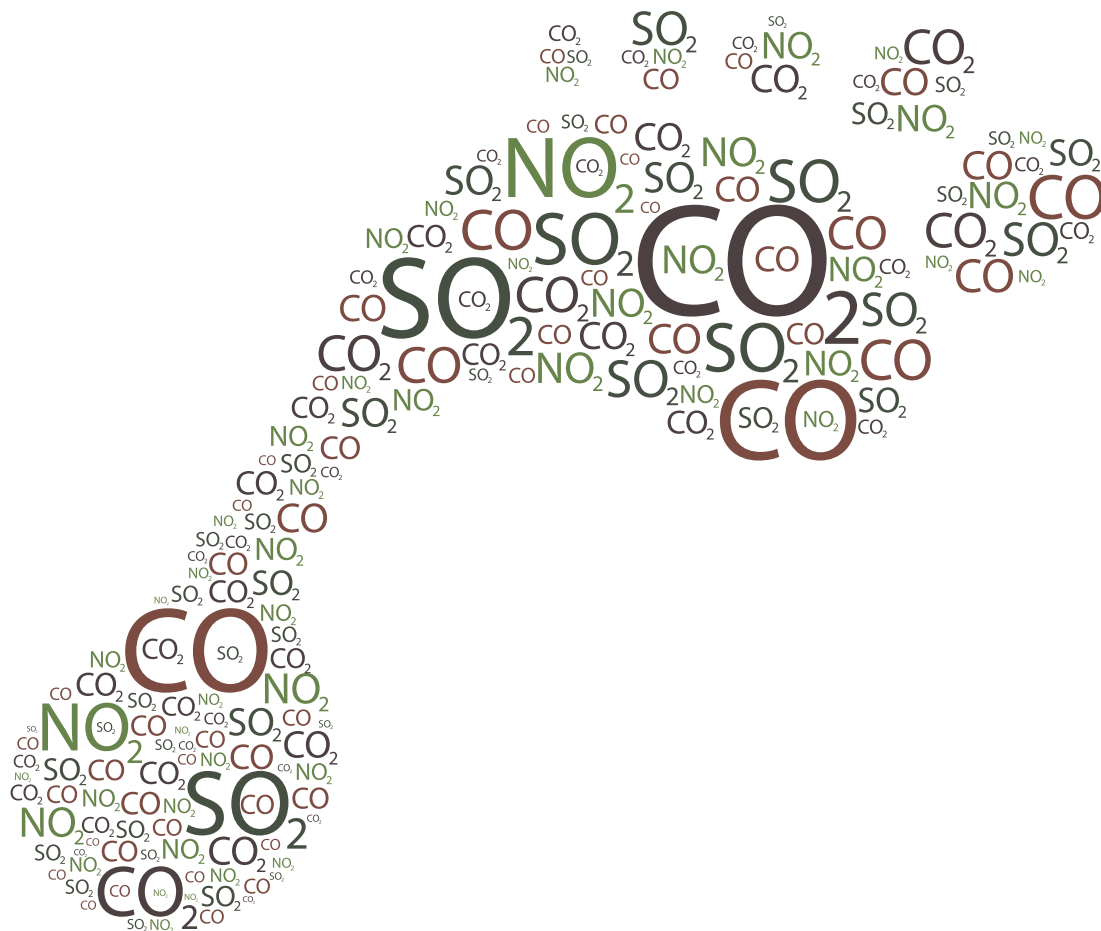
slowly, but effectively, dispelling all the myths and falsifications.

Fresh electric car registrations (both battery electric and plug-in hybrids) increased by 70% across the world between 2014 and 2015. More than 5 lakh electric vehicles were sold across the globe, out of which over 2 lakh electric cars registrations took place in China, making it the largest market for electric cars in 2015. According to industry lobby group, Society of Manufacturers of Electric Vehicles (SMEV), the EV sales figures in India saw a growth of 37.5% in 2015/16.

India's automotive sector, among the most rapidly growing ones in the world, houses the third largest automobile industry in the world and the world's seventh largest commercial vehicle manufacturer. Automobile sales across all segments have nearly doubled in

the country and two-wheelers have dominated the industry, with 79% share of the production in 2016/17 [Society of Indian Automobile Manufacturers (SIAM)]. Passenger vehicle sales in India in 2016/17 were above 30 lakh (3 million) units and is expected to hit 1 crore (10 million) units by 2020.

Perhaps partially due to this growth and partly to contain the country's growing carbon footprint, the government of India has ambitiously targeted selling only electric vehicles by 2030. Setting up the National Automotive Testing and R&D Infrastructure Project (NATRIP) centres as well as a National Automotive Board are other significant steps towards promoting innovation in the automobile industry. Considering alternative fuel is the need of the hour and since this presents a prudent solution to meet the







ever-increasing energy demand in our automobile sector, electric vehicles are on everyone's mind.

The government of India's flagship scheme, Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) to boost hybrid and electric technologies in India, initiated in April 2015. The scheme has two significant components of incentivizing the adoption of electric technology— earmarking funds under several components for a two-year period and a direct subsidy on the retail price of eligible vehicles. In early December 2017, the Karnataka state government announced tax exemptions for all electric vehicles bought in the non-transport sector, in a bid to promote alternative energy automobiles in the state.

According to a Bloomberg analysis report (2017), "By 2040, 54% of new car sales, and 33% of the global car fleet will be electric." In the wake of such a statement, the logical question arises

as to how will this pan out for India? Will these schemes and exemptions be enough for India to go completely electric? First and foremost, there is an immediate requirement for the electric vehicle network necessary to sustain and grow such vehicles.

While Indian millionaires are placing orders for Tesla cars, there continue to be gap areas mapped to the electric grid. Massive outages and power shortages throughout the year have been reported across the country, especially during summer. It is pertinent to note at this juncture that this is only the tip of the problem.

The technology revolution that has transformed India has also increased our hunger for electricity. Northern India predominantly consumes thermal generated power which implies that the electricity consumed comes from coal— so going green also means switching to alternative sources for power so that electric vehicles can actually help reduce the carbon footprint.

The reality, however, is that there are a few viable ways to reduce reliance on environmentally hazardous ways. India plans to achieve 175 GW of renewable energy capacity by 2022; of this, 100 GW is set to come from solar projects. The solar projects, however are yet to take off, and 2022 is only five years away with electricity consumption on an all-time high. Interestingly, an average household's electricity bill in Bengaluru was ₹500 in 2010; today it stands at ₹1200. That is more than double in seven years. This is partly attributed to inflation, but mostly due to consumption. Now, if you add an electric vehicle to the mix, will there be enough 'green' electricity to go around?

## Infrastructure

This, of course, brings us back to the question of public infrastructure. Charging equipment for plug-in electric vehicles (PHEVs or EVs) is classified by the rate at which the batteries are charged. The charging times vary based

on how depleted the battery is, how much energy it holds, and the type of battery. Depending on these factors, the charging time can range from less than 20 minutes to 20 hours or more. It is not as simple as going to a petrol pump and using any of the nozzles to fill up the tank. There is a lack of standardization for the battery capacity and manufacturers are yet to commit to a global standard. At present, there are at least four different types of connectors in the market. This essentially implies that the petrol/diesel fuel nozzle design, already standardized worldwide, needs to be standardized here as well. There have been major advances in inductive charging, and possibly in the future, EVs will be charged while they are parked.

## EV Policy and Initiatives in India

An EY report, titled *Electric Vehicles Adoption: Potential Impact in India*, provides an interesting perspective on how power and utility companies can play a major role in creating the charging infrastructure for EVs.

According to the report, power companies stand to gain from making the change themselves. "EVs stand to have a net positive economic impact of around ₹200 billion in the P&U sector in India by 2022. This can contribute substantially to the turnaround of the Indian P&U sector," states the report.

Another note, by the consulting firm Bridge to India, however, points to India's unpreparedness to go electric. According to the note, the country has made little progress in electric mobility since the announcement of the National Electric Mobility Mission Plan in 2013. "In comparison, China is a world leader in electric vehicles with over 50% global annual market share. Local manufacturers, such as BYD and BAIC are world leaders in this market. The country is considering ramping up progress even further and wants 8% of all vehicles to be electrically powered by next year."

The Indian government has also been trying to push the sales of EVs while simultaneously exploring a strategy that involves reducing the battery size to bring down EV prices. "The electric vehicles market is growing

rapidly worldwide fuelled by stricter environmental measures, technology improvements, and cost reduction in energy storage. It is also seen as a vital link in achieving energy transition. This explains the lead taken by the Union Power Minister, Piyush Goyal, on the electric mobility initiative despite automobiles falling under the ambit of the Ministry of Heavy Industries," according to the note. The consulting firm does not hold an optimistic view of the future. Despite all these innovations and milestones, there are several challenges that could be a deterrent even before the concept takes off in India. The Indian EV market poses formidable challenges for policymakers.

"The ambitions now need to be backed with actions. While India has a large domestic market, it lacks the fiscal capability and ambition of China and the technology expertise of Japan or South Korea," the note cautioned.

All this can change, of course, but only if cohesive and comprehensive planning is conducted to work out all the kinks; added to this is the actual cost of the car. An electric vehicle today in



India, despite all the exemptions, still costs significantly more than an internal combustion engine vehicle; this is a result of the cost of the battery itself.

In December 2017, at the eighth Global Entrepreneurship Summit, NITI Aayog, CEO Amitabh Kant said that there is a need to find a technological breakthrough to bring down the cost of the battery used in electric cars. "Despite all the talk, the total number of electric vehicles at present is only 1%," he had said. "Once that cost of battery falls, the cost of electric car would be equivalent to (that of) an internal combustion car. So, the challenge lies in making a breakthrough in battery (technology)."

In April 2017, the Automotive Research Association of India successfully tested lithium-ion batteries developed by the Vikram Sarabhai Space Centre for use in two- and three-wheeler vehicles. In India, the effect of this will be significant, especially in the two-wheeled EV segment, where the charging of the EV is as simple as pulling it in to a regular plug point at home.

Considering that two-wheelers continue to be the highest selling segment of automobiles in India, the infrastructure changes need to begin here. History has shown that specialized infrastructure requires an inordinate amount of time for implementation. Using this reasoning, perhaps India

should begin by taking small steps. As it is, the propaganda against EVs and the myths about the long-term environmental effects of lithium-ion batteries, will be an uphill battle.

With the proliferation of EVs, smart phones, laptops, and storage of green energy production, lithium-ion batteries are gradually witnessing rapid growth. Innovative battery designs, chemistries, and cell formats are being introduced for power performances in order to meet the advanced needs of products today.

As quickly as newer innovations and more challenging applications for LiB technology emerge, the science of safety in this technology, too, must be advanced. At present, there are several issues that dog the lithium battery sector. It includes lack of knowledge on caring for batteries, insufficient accreditation and training for designers and installers, lack of standards for recycling or disposing batteries, among others.

Despite the so-called evidence, it is well-accepted that EVs are better for the environment in the long run. Union Power Minister, Shri Piyush Goyal, in a press meet, stated that the growth of solar power and EVs in India are inextricably linked, given that EVs have batteries that can offer a storage solution to the country's clean energy push. As solar power generated during

the day needs to be stored in batteries, the storage capability of EV batteries could help with grid balancing. There is a considerable amount of manpower and money going behind making EVs and its batteries more attractive. Every major EV release from the marquee manufacturers have been gaining momentum. The predictions are that the global demand for EVs will skyrocket in the next two years.

Predictions are always tricky—at times leaning towards being overly optimistic. As solar electricity projects are being successfully implemented across the country, one could believe that society is becoming more environmentally conscious. However, it is important to mention at this juncture that the demand for viable EVs is currently being met insufficiently.

For EVs to take off effectively in India, apart from the incentives offered by the government, it should also look at providing a better infrastructure to lower the costs of manufacture and upkeep of the EVs. This is followed by the public infrastructure itself; much like the petrol pumps and repair shops for the traditional vehicle, there should be planning for charging stations and standardizing the charger and socket as well. Of course, to be green there should be green electricity as well. Looking at thermal power plants might not be the best way to reducing the country's carbon footprint.

In this, however, India is a trend-maker insofar as small capacity EVs are being used in urban areas for lightweight deliveries. Commercial vehicles manufacturer, Ashok Leyland launched Circuit in December 2016, an electric bus (price starts at ₹ 1.5 crore) which was test-driven by the Chennai Metropolitan Transport Corporation for six months.

## Barriers to EVs

However, going commercial is perhaps the final frontier that EVs aim to reach. There are so many other milestones to be crossed prior to that. To begin







with, turning public transportation electric should suffice since this will reduce the number of cars on the road. Compared to the Mass Rapid Transit (MRT) in Singapore which is structured and layered to incorporate trains, buses, and even taxi service, it looks unlikely that India lays claim to integrating these transportation systems at present.

In India, if we put it in context with the MRT, Metro in select cities is well connected and provides a comfortable, safe, and convenient way to travel; however this is limited to few cities. Other public transport systems have only been effective on paper. Thus, there are enough gas guzzling cars on the road, because they can't yet rely completely on public transportation.

Take into consideration the case of the Pune Smart City Mission: electrical buses (e-buses) will not run on the Bus Rapid Transit System (BRTS) corridors in Pune because of the mismatch between

floor height and the bus stop in BRTS. The proposal for electrical buses was passed in April 2017 by the Pune Smart City Development Corporation Limited board, and three such e-buses were to ply on trial basis. That is just one example of how unprepared India is. As lithium-ion batteries are charting new frontiers like electric cars, designers are constantly working towards resolving issues that come with breakthrough innovation, mostly relating to cell balancing and safety.

Safety of the batteries from possible explosion and low battery life act as spanner in the world of the Li-ion battery. Another major hurdle for EVs in India is charging, or the lack of charging stations, thereby making them impractical or less feasible for long distance drives. At the 2017 Global Entrepreneurship Summit, Amitabh Kant as a solution suggested that there should not be a monopoly in car

battery charging service, and for this, inter-operable charging points can be set up.

## EV Technology— Permutations and Combinations

In addition, there are the visionaries who try to realize the essence of battery swapping. Ashok Leyland has inked a strategic tie-up with Sun Mobility, a start-up borne out of a joint venture between Virya Mobility 5.0 in Bengaluru and private equity fund Sun Group's New Energy Systems. This is also the new venture undertaken by Chetan Maini, the innovator behind Reva, India's first electric car—owned by Mahindra & Mahindra since 2010.

As the future of internal combustion engines (ICE) looks a little turbulent and since the central government has had its electric awakening, Sun Mobility is

singularly focusing on the one barrier to commercializing electric mass transport: cost. The company is, thus, looking at battery swapping, which can be undertaken in charging stations at a large scale in Indian cities.

Instead of charging stations, a swapping station will immediately exchange depleted batteries with charged batteries and EVs will not have to wait to get charged. The EV driver pays for the depleted energy which can be measured because batteries are IoT-enabled (Internet of Things-enabled). It works on the pay-as-you-go principle. Sun Mobility plans to undertake the cost of owning, assembling, and maintaining lithium-ion batteries at these stations. That is, if the policy swings in favour of swapping stations.

As described by Chetan Maini, if the battery is separated from an EV, the cost of manufacturing the electric vehicle for automakers can be neutral when compared with a petrol-run vehicle. "It could be cheaper because EVs have far fewer moving parts than an ICE," he had said.

Essentially, this means that if Sun Mobility wants to undertake the battery cost in effect, and leave everything else in the manufacturing of an EV to automakers. The customer—ranging from auto-rickshaw drivers, bus service providers, two-wheeler riders and, in the future, car owners—will pay for the service.

According to Maini, the battery cost puts a strain on automakers' ability to produce EV at scale, especially when the demand is uncertain. Maini points to a mutual learning for EV innovators and automakers. "If you have to grow an EV business, you have to have a lot of investment and build by aligning with an automaker rather than doing it all alone," Maini had said in a news interview.

Before Mahindra & Mahindra bought out Reva Electric Car Company, it had gone alone at it for 10 years, despite a short-lived partnership with General Motors India for electrifying Chevrolet Spark. On the supply side, vehicle OEMs

(original equipment manufacturers) want to share the risk.

Consumers' inability to buy an EV, or even maintain it, is attributed to the battery cost. This would be like buying a petrol/diesel car today by paying for the fuel for next five years. Maini's hypothesis is that battery swapping will be a service solution for all. This could help customers and transport operators find a lower on-road price for the vehicle. At present, Sun Mobility is in talks with other OEMs for the same kind of engagement; it already will undertake the cost of developing and assembling batteries for Ashok Leyland's e-buses. Simultaneously, the company is also identifying locations and prospective franchises to run the battery-swapping stations. Its first station has been showcased in February 2018.

## The Road Ahead

The evolution of the EV industry has striking parallels with the smartphone industry. This is especially pertinent to the supplier base. Until 2005, everything in a phone was completed by the manufacturer internally. Today the manufacturing base is diverse—chips are manufactured by one player and battery by another—and thus, smartphone models are created every three months on an average. The GPS and other major apps, which are in the phone ecosystem, be it Android or iOS, are not owned by any smartphone brand. Electric vehicles, too, have the potential of spawning such a supply ecosystem. The major parts can come from separate places and the entry barrier will consequently be lower. According to Chetan Maini, the business of recycling lithium-ion batteries can have a large potential on its own if the EV industry kicks off.

Shifting to EVs will also significantly check pollution and fuel imports. India, the biggest emitter of greenhouse gases after the US and China, plans to reduce its carbon footprint by 33%–35% from its 2005 levels by 2030, as part of its

commitments to the United Nations Framework Convention on Climate Change adopted by 195 countries in Paris in 2015. However, all this is achievable only if there is progressive, not prohibitive, thinking. This has to be an all-hands-on-deck scenario to make it into a success, since at present this is a country where the rich buy supercars, with bumpers and underpinnings that will scrape at every corner, thanks to the poorly maintained roads. And after all, if regular citizens think of buying an electric car, it is imperative that the charging infrastructure comes along as part of the package. As of today, the charging needs to be fixed at home, if one can afford it, unless there are legislations and infrastructure in place.

## Suggested Reading

- » *Hybrid and Electric Vehicles in India: Current Scenario and Market Incentives*, The International Council on Clean Transportation Working Paper December 2016, Shikha Rokadiya and Anup Bandivadekar.
- » *Global EV Outlook 2017: Two Million and Counting*, International Energy Agency White Paper.
- » *Electric Vehicles Market in India*, E-Rep Market Research Series, October 2017.
- » *The Future of Mobility in India: Challenges & Opportunities for the Auto Component Industry*, McKinsey & Company, paper prepared for the 57th Annual Conference organized by the Automotive Component Manufacturers Association of India.
- » Anders Nordelöf's Thesis on *Life Cycle Assessment (LCA) of Electric Cars*, Chalmers University of Technology.
- » *Electric Vehicles Adoption: Potential Impact In India. A Power and Utilities Perspective*, Report by EY, July 2016
- » *India Auto Report*, October 2014
- » ET Auto, *The Economic Times*
- » Livemint – Industry **EF**

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# RIDING THE **GREEN WAVE**





For Lithium Urban Technologies, an electric car fleet startup based out of Bengaluru, 2016 began on a high note. Barely two years after giving the country's first 100% electric solution for corporate transport in India's Silicon Valley, Bengaluru, the company decided to make its grand debut in the National Capital Region, with its first client in March 2017, and is rapidly adding more vehicles to its current fleet size of 60 with new corporate customer sign-ups. The launch of the first electric cab service in the capital happened 16 years after India earned its first electric vehicle way back in 2001. **Shillpi A Singh**, through this article, describes this belated albeit welcome step for those willing to hitch a ride on the green wave.





## Driving Force

Going by its tagline that makes an audacious claim of providing tomorrow's transportation, today, Lithium Urban Technologies gives Delhi and its citizens, who are together battling the worst form of air pollution, enough reasons to rejoice. The capital has been witnessing prolonged spells of severe air quality at sporadic intervals, starting November 2016 when it faced the worst smog in 17 years and so, the idea of an e-fleet bodes well for corporates, who are willing to go that extra mile to reduce their carbon footprint on the environment. By subscribing to the services of electric cab service, they get rides that are hydrocarbon emission-free, non-renewable fuel free and pollution free, every single day.

Named after lithium-ion rechargeable batteries that power everything from cell phones to electric cars, the company had an uphill task earmarked for itself when it set out to power the urban transport system with electric vehicles (EVs). For kick-starting its ambitious project to bring electric cars in the mainstay of our commute, the company had to steer past a general lack of awareness for electric cars followed by perhaps the next

biggest hurdle. In a country notorious for power outages, how to have charging stations with uninterrupted power? But in two and a half years, Lithium with its fleet of 400 electric vehicles (EVs) on the road between Bangalore and NCR, has covered more than 20+ million emission-free kilometres, abated over 7000+ metric tonnes of carbon dioxide (CO<sub>2</sub>) emissions, made operational with 60+ captive fast-charging stations in the

two cities. The numbers speak volumes of the company's grit and determination in changing the landscape of transportation with its measures, today.

According to Joy Nandi, Head-NCR, "We set out to bring green public transportation to India with electric vehicle cabs, and we started our first client operations in Bengaluru in June 2015. But instead of venturing into the B2C segment of cab and taxi operators, we deliberately decided to stick to the B2B segment." The reason for this decision, he elaborates, is viability. "Despite the lower running and maintenance costs of EVs, due to the much higher costs of the EV and supporting infrastructure, a minimum amount of daily running kilometres per EV, the predictability of travel times and locations for charging is required, for which the B2B segment is ideal," he added.

### WHY LITHIUM?

- » Dedicated and connected fleet provides better control
- » Unlimited travel distance ensures transparency
- » Analytics drives high fleet productivity
- » EV fleet means flat budgets with zero fuel price escalations
- » 100% regulatory compliance
- » Trained drivers with verifications and certifications
- » An integrated offering of vehicle + drivers + technology + on-site and off-site teams
- » Real-time monitoring of an on-site vehicle NOC
- » Future proofed against emission regulations

## Steering Thought

Lithium's model of operation also challenged the conventional norms of thinking. "As a business, we chose to take on one of the oldest industries to try and professionalize it, seeing the same with very different operations and service level lens, while completely





moving away from how customers are traditionally billed by transport vendors on distance traversed or time for vehicle hire basis. Today, we own and operate our fleet, and charge companies monthly on a per-car basis, with unlimited mileage,” he quips.

In the last two and a half years of operations, the company has managed to keep the future of urban mobility and sustainability in mind and made the business commercially viable despite EVs being close to two times the cost of conventional internal combustion engine (ICE) vehicles. And it has been able to do so while ensuring an uncompromising view of compliance and governance standards, and safety and security of passengers. The electric cab company was EBITDA<sup>1</sup> positive within the first ten months, and cash positive within the first 25 months of operations.

## Wheeling Charges

Sanjay Krishnan, and Ashwin Mahesh established Lithium Urban Technologies with a vision pivoted on three pillars—sustainable urban mobility, professionalizing the transport ecosystem, and integrated services backed by a strong technology and analytics platform. “We realized that the future of urban mobility would be based

on four key tenets—Clean, Connected, Distributed, and Shared. The world of EVs allowed the company to explore the world of sustainable transport, exploit the energy arbitrage between fossil fuels and electricity as a fuel, and essentially break the paradigm of larger distances or greater kilometerage implying proportionately higher transport costs,” says Krishnan. “India as a country has the maximum difference between the pricing of hydrocarbon and electricity. Therefore, India as a starting ground for such an idea was great,” he adds, on the idea of negating fuel costs and the degradation to the environment

“WE UNDERSTAND URBAN MOBILITY AND HOW TECHNOLOGY BEST ADDRESSES THOSE NEEDS. OPTIMIZING OUR FLEET AND INFRASTRUCTURE FOR VARIOUS DUTY CYCLE REQUIREMENTS KEEPS US CUSTOMER CENTRIC AND OUR FLEET MORE PRODUCTIVE AND ENERGY EFFICIENT THAN THE NEXT BEST ALTERNATIVE. BRINGING TO BEAR OUR UNDERSTANDING OF EVs AND THE UNDERLYING TECHNOLOGY DRIVERS TO SERVE THE VARIOUS MARKET SEGMENTS MOST EFFICIENTLY IS CORE TO OUR VALUE PROPOSITION.”

## CHETAN MAINI, MAXIMIZING ELECTRIC MILES @ LITHIUM

brought on by hydrocarbon cabs by using an EV only fleet. In countries with poor electricity supply but abundant alternative energy, electric cabs make

### LITHIUM URBAN TECHNOLOGIES

*India's first 100% EV-based commercial fleet operator*

*Commencing operations in mid-2015, Lithium has pioneered a new concept in the country's urban mobility by demonstrating EVs' commercial and operational viability in fleet operations.*

- » The company currently caters to the corporate employee transport sector in Bengaluru and Delhi with an all-EV fleet. It plans to commence operations in Chennai, Pune, Hyderabad, and Mumbai during FY18.
- » Lithium has built an analytics platform that enhances vehicle and charger productivity, resulting in 10%–30% reduction in transportation costs for its clients.
- » The company managed to set up its own city-wide captive charging stations overcoming the challenge of a non-existent EV ecosystem.
- » Lithium has been chosen by the Government of India to build 60 public DC fast charging stations across NCR.

*The company's core philosophy of “Sweat the Car and Not the Driver” ensures a sound working environment for its drivers along with financial inclusion and social mobility (with career path options).*

<sup>1</sup> Earnings Before Interest, Taxes, Depreciation and Amortization



even more sense. “Electric vehicles cost almost twice as much as their ICE counterparts, but running costs are a concern, so our prices are 10% to 30% lower,” he says. “And servicing blue-chip corporate clients who operate out of commercial complexes with 24/7 power supply also means overcoming any charging issues related to power outage”.

## People First

The idea of professionalizing the transport ecosystem helped plug a huge gap. While India is known all over the world for its offshoring/outsourcing and software development industry, a critical piece that enables this ecosystem—Corporate Employee Transport—which transports millions of employees day in and day-out in multiple shifts and during the wee-hours of the night, transport continues to be one of the most unorganized, untrustworthy, inefficient, and exploited industries. The demand is more than the supply, and there is no incentive for vendors to control all aspects of the transport business. In today’s corporate transport ecosystem, the transport operations are being managed by one party, the technology

stack is provided by another, and the actual vehicles and drivers are serviced by a third. There are a lot of gaps which get exploited in this model, leading to inefficient and inconsistent service levels, and issues with compliance and governance. Even if there are certain professional fleet aggregators, they still source sub-vendor-attached vehicles, which in turn exploit the blue-collared worker—the driver.

“At Lithium, we fundamentally believe that if the transport ecosystem needs to be professionalized it needs to first start with our driver-partners. There needs to be respect for all individuals, dignity of labour, pay for performance, an inordinate focus on skill development (related to both transport and code of conduct), and most importantly—financial and social inclusion. Only when drivers are truly happy, and they see a path for progression, an impact on their families, will they stay longer, and truly generate the return on investment on the upfront training and up-skilling that Lithium invests in them,” adds Nandi. The company provides above-market compensation, private healthcare insurance, accident and

disability insurance, access to banking and savings products, emergency cash advances, paid leave of absence, transparent and timely e-settlement of dues, and career progression to fleet management, training, and recruitment roles. The investment on the workforce bodes well for the company; it has the best drivers and the lowest attrition rate. The company has a formal driver assessment and selection process as well. The background verification checks of all drivers are conducted through an accredited third-party approved vendor, and the data is available online on Lithium’s fleet management system. “All our drivers undergo a mandatory 5-day training, online test and certification process, and all of them are trained and certified in defensive driving by Hubert Ebner,” says Krishnan.

## Tech Smart

Lithium’s integrated services approach brings the world of vehicles, drivers, technology, and operations under the same roof, something we believe no one else has yet managed to master. “Our past 2.5 years of operational experience in this integrated manner,

and the first-mover advantage of even doing this with EVs is a unique proposition in the marketplace,” quips Krishnan. The technology platform is a combination of fleet scheduling and management system, specifically designed for EVs, along with driver and passenger mobile apps for tracking and monitoring the vehicles and trips. “We contract directly with corporate clients, and then implement our integrated services to blend in our EV fleet along with their existing transport operations,” says Nandi. Using the information on all parameters related to the vehicle, including trip details, charge status, service levels, and maintenance via a cloud-connected platform helps the company optimize operational costs. The technology prowess of the company is equally matched by a strong executive management team and professionals who are extremely talented, passionate, and motivated. The company currently has about 90 full-time employees and more than 900+ drivers directly associated with it.

The company’s current fleet of 400+ cabs comprises E2O (2-door variant with 100 km range/charge), E2O Plus

#### LITHIUM URBAN TECHNOLOGIES NUMBER WISE

- » 100% electric fleet of ~ 400 EVs
- » EBITDA positive within 10 months
- » Cash positive within 25 months of operations
- » Clocked more than 20+ million km
- » Abated 7000+ MT of CO<sub>2</sub> emissions to date
- » Partnered with 900+ drivers
- » Vehicles run 250–300 km per day
- » Deployed 60+ captive fast-charging stations in 2 cities

(4-door variant with 140 km range/charge), and Verito Electric (4-door Sedan with 110 km range/charge). The company is expected to add new form factors in partnership with other original equipment manufacturers (OEMs) in the near future.

### Speeding Ahead

EVs are the future of urban mobility, but despite the push by the government for mass adoption and utilization of EVs to address problems of air pollution in cities, there are several challenges related to cost of asset, product quality,

inadequate charging infrastructure, limited battery range, and federated state-level issues related to transport and traffic authorities. There is also push-back from auto-OEMs who have invested a lot in traditional ICE vehicle assembly lines, and for all of them, the transition to an EV-only world is quite daunting. Product quality will only improve if more robust products from multiple OEMs are available in the market. Issues related to import-barriers, high-cost of battery, etc., still need to be addressed to enable growth of the market. Despite these overbearing challenges, Lithium has proven that EVs are commercially viable, while also helps auto OEMs improve the product with its data-backed analysis of EV performance, building the captive charging infrastructure on their own when none existed, and above all demonstrating to their clients that the transport ecosystem can be ostensibly professionalized with improved service, compliance, and governance levels. “With every city where we hit the roads, and where we endeavour to operate in the next financial year (FY), all the issues will be similar related to







## HOW MUCH IS 1 TONNE OF CO<sub>2</sub>?

**1 tonne of CO<sub>2</sub> is emitted when one**



Burns 350+ litres of diesel



Uses 300 kg of standard office paper



Travels 25,000 km by train



Breathes for 500 days

**1 tonne of CO<sub>2</sub> looks like**



500 CO<sub>2</sub> fire extinguishers



A 200 m<sup>3</sup> hot air balloon



125 m<sup>3</sup> cola bottle



charging infrastructure and transport regulatory authorities, but these will be overcome," says Nandi on an optimistic note, adding, "We are now working with the government and related stakeholders like electricity distribution companies and charging station OEMs to help set up and operate public charging infrastructure which can be used by both our fleet, and any third-party individual user or fleet aggregator. We are also working with academic partners to help bring in standardization for communication protocols between the charging

stations, end-users, and the electricity grid."

The company is looking to expand its operations in Chennai, Hyderabad, Pune, and Mumbai in early 2018. "We hope to stay ahead of the curve by introducing many other variants of EVs in different business segments other than corporate employee transport, and also introduce new business models for making transport as a shared service," says Krishnan. **EF**

*Shillpi A Singh is a freelance journalist based in Delhi.*

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# IN-EV-ITABLE ADOPTION OF ELECTRIC VEHICLES

## The Road Ahead

Electric vehicles, an eco-friendly mode of transportation, have captured everyone's attention and fostered discussions on their increased acceptance. Identified as eco-friendly insofar as they release no tailpipe emissions, EVs seem to be the preferred vehicles in today's day and age with growing concerns over air pollution. **Monika Paliwal** explains their need, significance, and charts the future of EVs in India, through a detailed discussion on these parameters.



### Need for Electric Vehicles

In recent times, the various parameters of Delhi's air quality index, used to report the quality of air/ its forecast, report the polluted air quality and how vehicular emissions is one of the leading cause. The report of the Environment Pollution (Prevention & Control) Authority (EPCA) on air pollution in the capital highlighted the momentous role of vehicles and vehicular emissions in

degrading air quality in Delhi and how rapid motorization, based on poor quality fuel and vehicle technology, will make the air pollution trend irrevocable in years to come.

Metropolitan cities in India suffer from immense air pollution. One of the leading causes of dwindling air quality is the rising number of vehicles on road which are running on diesel, petroleum, and compressed natural gas (CNG). An array of air pollutants emitted from vehicular emissions, such as carbon

monoxide, nitrogen oxides, particulate matter, volatile organic compounds, and benzene, contribute to complex problems, for instance, the urban air quality issue of photochemical smog that has adversely affected human health and the health of flora and fauna. Therefore, electric vehicles (EVs) are an alternative to conventional fuel driven vehicles.

According to the EPCA Report on *Priority Measures to Reduce Air Pollution and Protect Public Health*, Delhi has more





than 7.4 million vehicles on its roads and 1,200 vehicles are being added each day, leading to creation of pollution 'hotspot'. In fact, Delhi's air pollution has variously been referred to as a 'gas chamber', and a 'public health emergency'.

## Kinds of Electric Vehicles at a Glance

Categorized according to the degree of electricity used as their energy source, EVs are classified as follows—Hybrid Electric Vehicles (HEVs) powered by both petrol (conventional mode) and electricity; Plug-in Hybrid Electric Vehicles (PHEVs); and Battery Electric Vehicles (BEVs). In terms of energy efficiency, EVs can convert about 59%–62% of electrical energy from

grid to power at wheels whereas conventional fuel-powered vehicles can convert about 17%–21% of the energy stored at conventional sources to power at wheels. Thus, EVs are equipped with substantive performance benefits. Their added benefits include electric motor that can provide smooth operation and stronger acceleration and require less maintenance than internal combustion engines (ICEs).

However, certain issues hinder people from full-fledged dependence on electric vehicles. EVs face significant battery-related challenges. The battery costs are usually high and in the long run may need to be replaced more than once. Charging is a time-consuming task for EVs as a full recharging of the battery

pack can take at least 4 to 8 hours. Even a 'fast charge' of 80% capacity can take at least 30 minutes. EV charging is not quite efficient, that is, it needs to be pulled inside a charging station, compared to a conventional fuel station where tank filling takes a fraction of a few minutes. Added to this is the fact that each battery pack is heavy and takes up considerable storage space. On roads, EV driving range is typically limited to 60 to 120 miles on a full charge although a few battery models can have a driving range of 200 to 300 miles. Based on ground reality, the heavy investment related to the charging infrastructure of EVs poses a significant speed breaker. According to state-run Energy Efficiency Services Ltd (EESL), the major roadblock



in realizing the government's e-fleet vision is the lack of e-vehicle charging infrastructure. In tandem, researchers are working on improved battery technologies to increase driving range, reduce charging time, weight, and cost. These factors once improved will strengthen the acceptance of EVs in the future.

## EVs in India

India is moving on the path of achieving the Sustainable Development Goals and has taken up an initiative for increasing the EV fleet on Indian roads. This has been acted upon by governments' National Electric Mobility Mission Plan launched in 2013 which aims at gradually ensuring a vehicle population of about 6–7 million electric and hybrid vehicles in India by 2020. The vision is expressed to ensure 100% EVs by 2030 in the country. A significant step in this direction in November 2017 is the launch of the nation's first EV charging

station at a petrol pump in Nagpur as a collaboration between state-owned Indian Oil Corporation (IOC) and Ola, an Indian online transportation network company. As affirmed by the official company statement, IOC, in association with Ola, has launched the country's first electric charging station at one of its petrol–diesel stations in Nagpur. According to the statement, "As India's leading oil refiner and marketer, IOC considers promoting ecological sustainability as part of its core business. Thus, this partnership with Ola is the right step forward as we re-imagine how India will commute in coming years". Thereby, making Nagpur the first city to introduce the electric public transportation model in India.

According to IOC's Annual Report for 2016/17, the organization expressed its plan to set up battery charging stations and is exploring the manufacturers and retailers of lithium-ion batteries. They have further planned to introduce a fleet of 200 electric vehicles, including

taxis, buses, e-rickshaws, and autos, for public transport. Accompanying this is the announcement by Mahindra Motors that it would be supplying 100 e2O Plus electric vehicles and Nagpur authorities have procured the remaining 100 vehicles through Tata Motors, Kinetic, US electric vehicle maker Build Your Dreams (BYD), and TVS, to name a few. These efforts have been reflecting in the sales figure of EVs that has witnessed a 37.5% rise in recent years. Hence, the market for electric vehicles is growing rapidly in India, acknowledging the government's commendable efforts to make India an all-electric nation by 2030.

India is a promising and exciting market for car makers as it is the fifth largest car market in the world (as classified by ICRA Ltd, an independent Indian and professional investment information and credit rating agency). During the financial year 2017 as per a recent report, more than 3 million cars have been sold. The Indian market is lucrative and holds huge potential