

Future of sustainable personal mobility solution in India

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Abstract: . Transport accounts for about 19% of global energy use and 23 % of energy related CO₂ emissions and these shares will likely to rise in the future. As a result of growing GDP, India's primary energy consumption is expected to increase by 70% in the next ten years. The gap between domestic crude oil production and consumption is widening, leading to increase in imports and consequent impact on the trade deficit. This poses a serious challenge to India's energy (fuel) security. The transportation sector accounts for about one-third of the total crude oil consumption and the road transportation accounts for around 80% of this consumption, hence greater adoption of advanced technologies including battery operated EVs (full range of electric vehicles that include hybrids, plug in hybrids and pure electric vehicles) can provide significant contribution in enhancing energy (fuel) security and provide sustainable mobility.

Passenger vehicles have added a great convenience to mankind in terms of mobility. However the increasing vehicular population has also posed a great challenge of environment pollution and sustainability of fossil fuels. It has now been realized that problem of pollution has far outweighed the convenience of personal transport. Having said that, neither of the two can be wished away.

The case study helps to analyze the issue of sustainability of fuel for personal transport in India. It explores the feasibility of the various alternative fuel options available to the Indian consumer. The case also examines the future of electric vehicles in India and the impact of Government subsidies on electric vehicles.

Key Words: Sustainability, alternative, fuels, personal transport, electric, vehicles

Introduction

The Brundtland Report published in April 1987 defines sustainability as meeting the needs of the present without compromising the ability of future generation to meet their own needs.(Baue 1987). The report formed an important step in the debate around social responsibility and sustainability issues and particularly regarding the role that society demands of its for-profit organizations.

The world is tottering under the burden of high gasoline prices. The signs of climate change and global warming are now evident and pollution is really one of the root causes .Transport accounts for about 19% of global energy use and 23 % of energy related CO₂ emissions and these shares will likely to rise in the future . Given current trends transport energy use and CO₂ emissions are projected to increase by nearly 50 percent by 2030 and more than 80 % by 2050.

In India, the transport sector accounts for one-third of the total crude oil consumption and the road transportation accounts for more than 80% of this consumption. India's consumption of crude oil continues to outstrip demand. According to the data provided by the Petroleum Planning and Analysis Cell¹, petrol consumption in India was 12.35 million tons. India is expected to end up consuming 14.82 million tons of petrol in the year, registering growth of 4.41% in FY12. Consumption of diesel is expected to be 63.91 million tons, registering growth of 6.4%.

India has been exploring the prospect of reducing its dependence on crude oil. Lot of potential was seen in promoting ethanol as an alternative fuel as in Brazil, where more than 90 percent of new vehicles sold can run on either ethanol or gasoline. There are mandatory blending requirements for ethanol and the government has announced a policy for biofuels (such as biodiesel/biopetrol) from various sources. However, none of these have taken off in a sustainable manner

The National Electric Mobility Mission Plan (NEMMP) expects that 92% of all consumed crude oil will be imported by 2020. Electric transport is seen as a lever to reduce crude demand

Electric vehicle

¹ <http://www.hindustanpetroleum.com/en/ui/biofuels.aspx#H10>

Electric vehicles are battery operated vehicles which means a vehicle intended for road use powered exclusively by an electric motor whose traction energy is supplied exclusively by traction battery installed in the vehicle. EV comprises of electric cars, three wheelers and electric two-wheelers.

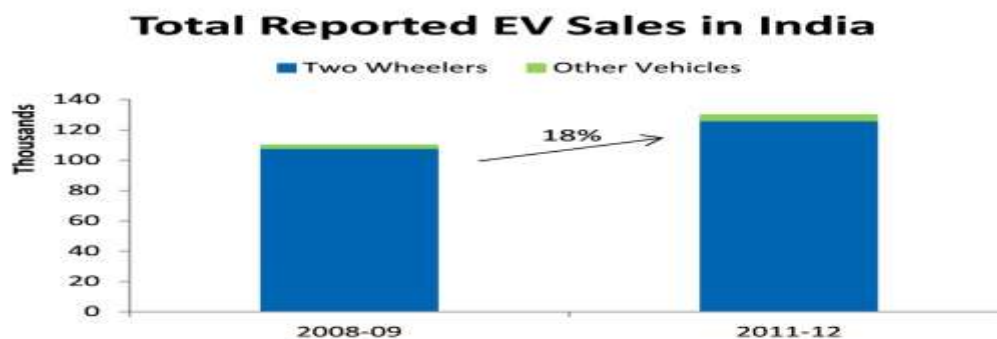
The electric vehicles (passenger cars) industry, globally, is estimated to be a tiny 100,000 units by the end of 2012. Currently, Nissan leads the market with the electric Leaf in Japan, the US and Europe, with about 40,000 units sold by the end of 2012. Nissan is ramping up the capacity to about 100,000 units by adding two new manufacturing sites in the US and the UK. China's adoption of electric vehicles is way ahead of other countries, with an estimated 100 million currently on the roads, and around 30 million produced annually, the majority of them being two-wheelers. This has been possible, thanks to strict municipal laws in certain provinces that have banned pollution-spewing ones.

Indian demand in the overall EV market is sluggish. Currently, there are about 4, 00,000 electric two-wheelers and 1,500 electric cars in India. Merely 1 % of two-wheeler market in India is electric two-wheeler E-car market is 2-3% of the car market. Electric vehicle (EV) market in India is at a nascent stage and is expected to grow by 45% over 2008-09 and 2009-10. Electric two-wheelers dominate the market with 97.5% of the EV market.

Soon, Indian electric vehicle manufacturers are expected to launch electric motorcycles. Given that motorcycles account for more than 80 percent of all two-wheelers sold in India, the introduction of electric motorcycles could have a significant impact on the market for electric vehicles. (KPMG 2010)

High upfront costs and service anxiety around re-charging/maintenance facilities have been barriers to sales growth. Only 130,000 hybrid and electric vehicles have been sold in 2012, according to media reports. The market is dominated by two wheelers, with 97-98% of sales occurring for electric bikes, scooters and motorbikes. In the 4W market, the financial case for investing in HEVs/EVs is weak. The costs of energy storage technology need to decrease so that EVs can financially compete with fuel efficient 'normal' vehicles. To boost the sagging sales of electric vehicles, the government approved the extension of the Ministry of New and Renewable Energy (MNRE)'s subsidy scheme to incentivize sales of electric cars and two-wheelers in the country. Sales of electric vehicles have declined as much as 65 per cent since the discontinuation of the MNRE scheme in March 2012.

Figure 1: Total Reported EV sales in India



Sluggish EV sales in India 2008-2012 (Source: Media reports; SMEV press statements)

India's move to popularize electric vehicles has skidded on policy flip-flop and consumer propensity to opt for the cheaper fossil fuel-driven variants. The size of the domestic market for electric vehicles, primarily two-wheelers, has more than halved over the past two years, forcing about half a dozen manufacturers like BSA Motors, Ultra Motors, Luminous and Eco Motors to shut shop.

Electric cars

The passenger car owners of India in mini and compact segment can be broadly classified into two major categories:

- 1) Mid-income household that either does not own any personal vehicle or owns a two-wheeler and aspires to buy a car: These households typically prefer mini and/or compact segment cars that fit their budget. Installation of Compressed Natural Gas (CNG) or Liquefied Natural Gas (LNG) kit for another Rs. 30,000-40,000 reduces their fuel cost by 60-70 per cent as compared to petrol.
- 2) High-income households that already own personal vehicle(s) but want additional vehicle for female members or for their young children. These households may either opt for a new but mini or compact segment vehicle for such requirements.

Various players in the Indian market

REVA, India's first electric car was developed and commercialized by REVA Electric Car Company (RECC), a joint venture of Maini Group in India and AEV LLC of California, USA. Available in three variants and six different colors REVA's strategy is to sustain its competitiveness by continuous improvement in its design philosophy. REVA has the following amenities; a battery operated electric car, totally pollution free vehicle, an onboard charger to facilitate easy charging, that can be carried out by plugging into any 15 Amp socket at home or work.

Market Research reveals that 98% of the urban population in India travel an average of only 40 kms a day and require a maximum speed of 40 km/ hr. Hence REVA is ably suited for the market requirement for city mobility.

The scenario for electric four-wheelers is grimmer — only about 2,000 electric cars were sold in almost a decade. The country is home to Mahindra Reva, the world's largest electric carmaker that can roll out 30,000 units a year. Manufacturers say lack of government incentive has added to their woes.

"We are struggling to maintain a healthy sales traction... Concerns over battery and the higher price compared to petrol or diesel vehicles have also worked against customer acceptance," said Chetan Maini, CEO of Mahindra Reva. Demand for Reva in India has largely been stagnant — less than 500 cars sold in a year.

Over the last few months, the company, Mahindra Reva has showcased a range of next-gen technology and service offering which will make it easier for consumers to own an electric vehicle. As part of their innovative measures, they have introduced Goodbye Fuel, Hello Electric scheme and Quick2Charge technology for the convenience of potential e2o customers. Under this, the company separates the acquisition and usage cost of the e2o to make the car more affordable under which you pay only for the distance you drive. (Economic Times, April 2014)

The company has also launched a new smart port technology that enables intelligent control of bi-directional transfer of energy to and from the electric vehicle. The smart port supports Quick2Charge® (DC Fast Charging), Sun2Car (Solar Charging), Car2Home(technology by which e2o can power your home); all from a single port in the car.(Economic Times, 23rd April 2014)South Korea's LG Chem Ltd plans to supply batteries for electric vehicles that can travel more than 200 miles (321 kilometers) per charge in 2016, .

Alternative fuel options for Indian consumer in car segment

Dieselization of car segment

Even before diesel could be cleaned up diesel car numbers have begun to gallop in India. From just 4 per cent of new car sales in 2004 it has exploded to 34% in 2010-2011

Figure 2: Diesel car sales in India



Under the current level of European emission standards that India has adapted, diesel cars are 'legally' allowed to emit nearly three times more NOx than the comparable petrol cars and also several times more particulates. Petrol vehicles have negligible emissions of particulates, while every diesel car is allowed to emit 0.05 gm/km in the Euro III norms. Petrol vehicles on the other hand are given higher limit for CO, as compared to diesel. But diesel related pollution is of serious concern in Indian cities. Standards are not fuel neutral.

CNG

Globally as well, CNG is increasingly becoming a favored mode of fuel. Outside the hybrid technologies, it is the cleanest fuel available with CO₂ emissions, 20% lower than a conventional gasoline vehicle. With the recent hike in petrol prices, the Indian vehicle buyer's preference towards natural gas has only gained momentum. It makes better sense to fit a Compressed Natural Gas (CNG) kit in their old petrol cars. The transition from traditional fuels towards natural gas is slow yet certain.

It is believed that at least 5 percent of new car buyers in India opt for a CNG variant where available. This could grow in the future as the demand increases for vehicles with lower running costs, although currently most LPG/CNG variants of passenger cars cost about INR 15,000 to 50,000 more than their conventional counterparts⁹. The higher purchase price of dual-fuel cars is normally compensated in less than two years based on cost per km, because dual-fuel cars offer up to 50 percent savings¹⁰ based on current prices of petrol and CNG. The increasing availability of fueling stations in cities and on major highways is also encouraging sales. (KPMG 2010).

However, in India, CNG prices have gone up considerably and are likely to increase further. The prices have already overtaken diesel prices in Ahmedabad by 15%, leading to an 80% fall in CNG vehicle sales in the city after price sensitive Indian consumers switched to diesel- and petrol-run cars. The same may be replicated in Mumbai, Delhi and other Indian cities too as CNG are likely to lose its competitive edge in the next six months or so.

With CNG prices becoming comparable with diesel prices, customers will be choosing between diesel or CNG as compared to petrol at least till the diesel prices go up further and restore the cost advantage to CNG.

The car industry has been slow to respond. This market is largely driven by after market conversion. OEMs have shown little interest as there is no regulatory directive for cars and this market has been slow to develop. Only a couple models that are popular in the taxi segment were initially made into CNG models by the Tatas and Maruti Udyog Ltd.

However, very recently, the car industry has begun to show interest in product diversification and the car majors including Tatas, Maruti Udyog Ltd, General Motors etc. have announced more CNG car models. This has been triggered largely by the growing consumer interest in CNG cars and spurt in after market conversion that followed the recent hike in petrol and diesel prices.

The trend is also to introduce bi-fuel products for the Indian market which provides the twin benefits of being economical as well as environment friendly. Tata Motors Ltd in Oct 2013 launched the Compressed Natural Gas (CNG) version of its small car Nano.

The new bi-fuel product,² ‘Tata Nano CNG emax’, that can run on gasoline as well as CNG, will cost Rs 2.45 lakh for Nano CX and Rs 2.72 lakh for Nano LX, ex-showroom Ahmedabad, The price difference between the petrol and CNG versions of Nano is about Rs 44,000. The new product is expected to attract customers in states like Gujarat, NCR, Maharashtra and Tripura, where CNG is available.

Electric scooters

Electric scooters is a battery operated two wheeler based on electric technology that replaces traditional petrol engine with electric motor. Electric scooters generally have a speed of 25 km/hour with a maximum of 50-55 km/hr for some special models. Battery of the scooters can be charged easily with normal power socket and typically takes 6 to 7 hours to charge fully. One charge can cover up to 100 km.

The basic transport nearly every urban house-hold in India use is a two-wheeler. On an average an Indian travels 300 KMs a month in his/her motor-bike (In cities people travel even more), which costs more than 400 Rupees per month. If they commute daily in electric bike, they can save at least a 50% (including the battery replacement cost) of what they spend on petrol-vehicle which amounts to a saving of Rs. 200 to 400 a month based on the distance they travel. This is the direct benefit. .

The advantages of electric scooters are they are highly economical compared to their petrol counter parts. Electric scooters are totally pollution-free. Electric scooters with motor capacity not more than 250 Watts need not be registered. Electric scooters up to 250 W need not be insured and no road tax need be paid. For riding electric scooters up to 250 W one need not have a driving license and wearing a helmet is not mandatory.

There are some limitations of electric scooters currently available in the market .Firstly, they are not powerful enough. They take 6 to 8 hrs. for fully charging the battery while filling petrol in a conventional scooter takes some one or two minutes. Charging stations for electric scooters are very few. The battery pack has to be replaced once every two years or so which costs considerably. Electric scooters cover only 70 KM at the maximum after a full charge of the battery while a conventional scooter can cover some 300KM or more with full tank fuel. Level roads only are suitable for electric scooters as they are unable to manage steep ascents. Electric scooters cannot attain high speeds. A 250W scooter can attain a maximum speed of just 25 KMpH while conventional scooters can go up to 80 or 100KMpH. In spite of all these limitations electric scooters are very costly, price being not much less than that of conventional scooters.

Cost per km of electric scooter vis-à-vis petrol is substantially low as indicated in the table below:-

Table 1: Comparison of Running cost: Petrol vs. Electric two wheeler

Battery (Ah)	20 ah	
Parameters	Petrol Two wheeler	Electric two wheeler
Fuel unit	1 litre	1
Fuel cost per unit (Rs.)	78	5
Mileage per unit	45	70
Cost per km(unit/mileage)	1.73	0.07

Source: www.Yobike.com

² **Bi-fuel vehicles** or otherwise known as **dual fuel** are vehicles with multifuel engines capable of running on two fuels. On internal combustion engines one fuel is gasoline or diesel, and the other is an alternate fuel such as natural gas (CNG), LPG, or hydrogen.^[1] The two fuels are stored in separate tanks and the engine runs on one fuel at a time in some cases, in others both fuels are used in unison. Bi-fuel vehicles have the capability to switch back and forth from gasoline or diesel to the other fuel, manually or automatically.^{[2][3][4][5]}

In the Electric scooter market, there are various players such as

Green Electric	Green Electric Flamz
Paradise Electro Auto	myEbike Classic
Electrotherm	YO EXL, YO Xplor, YO Style, YO Electron ER and YO Spark. These are sold in the price range starting from Rs 22,000 Rs 32,000 (approximate)
Hero Electric	Maxi, Optima Plus, Wave DX, Zion, Cruz, and E-Sprint costing in the range of Rs 38,000 - 44,000
TVS	TVS Teenz Scooty Electric
Ampere Vehicles	Abhi, Adya, Angel, Aditi, Bobo Retro, Buddy, Pearl, Prince, Trishul, V60, Visva DD and Zeal

Compiled by the authors from the net

Besides the above big players, there are some small players like the Pune based brand manufacturer , Miracle 5 .Miracle 5 works on positive word of mouth, runs a call center and provides a good after sales service to its customers

The number of electric two-wheelers on Indian roads plunged by 1,00,000 in five years to 4,00,000 in 2013, a drop manufacturers blame on inadequate charging support and limited speed options although In the two-wheeler market, an electric scooter is available for less (about USD 600) than a conventional scooter (about USD900)

However, electric two-wheelers have seen a recent reversal of fortunes, with sales dipping from a high of more than 26,000 vehicles in 2008-09 to around 3,000 in 2009-1014, attributed by industry sources to the rush of cheap, but low-quality vehicles which flooded the market in 2008-09 but then were subsequently rejected by consumers. Arun Pratap Singh, Senior VP of electric vehicle business Electrotherm, argues that this was partially due to a huge influx of low cost Chinese models which had quality constraints. “A lot of fly-by-night companies had started operating in India who sold inferior quality models at cheap prices but did not provide any service support,” he says. “As the customers became aware, these companies had to shut up shop resulting in a decline in numbers. As a result, the entire electric vehicle industry has earned a bad name and because of this the industry overall witnessed fewer sales in this segment. However, things are changing now, with the introduction of new models, Electrotherm is seeing growth in electric two wheeler sales month over month” He is also expecting 2010 numbers to bounce back on the strength of a service support network being developed to address any customer problems.(KPMG 2010)

Other indirect benefits/advantages of Electric bikes includes saving of foreign exchange worth close to 1 Billion \$ (approximate) by reducing the oil imports (There are approximately around 75 Million motor-bikes in India). Replacing all two wheelers in a year is impractical; this benefit is gradual over a period of 10 or more years. Unlike electric-cars the electric-bike’s battery, which is of smaller capacity can be charged with solar charger. So there is a potential of electric power saving. The electric bike when parked at home with fully charged battery could become an inverter/UPS when power failed at home. The lesser pollution surely benefits the environment. Domestic electric and electronic companies gets benefited from local design and manufacturing what is called as ESDM (Electronics System Design and Manufacturing).

Government subsidy

Under the National Electric Mobility Mission Plan (NEMMP) 2020, which was announced by the government in 2011 but is still to be rolled out, the electric vehicle manufacturers are to get incentives worth Rs 14,000 crore over the next six years.. According to Society of Manufacturers of Electric Vehicles (SMEV) Director Sohinder Gill "NEMMP 2020 has reached the final leg of approvals. We expect it to be implemented in the next 3-5 months. It will help the industry to recover said “The target of the plan is to have 6-7 million electric vehicles on the Indian roads by 2020. It will help save 2.2-2.5 million tonnes of fuel," Gill said.

Elaborating further, he added that lack of incentives from the government has led to a drastic fall in sale of electric vehicles over the past few years in the country. "Since the government took away subsidy in March 2012, the electric vehicle sales have gone down drastically. We sold one lakh vehicles in 2011-12, 42,000 units in 2012-13 and the sales have now come down to 21,000 units in 2013-14," Gill said.

In the 2014 budget, buying a hybrid or an electric car may soon fetch you a subsidy from the government, which is readying an Rs 14,000-crore scheme to push green vehicles (The Times of India, July 2014)

The heavy industry ministry, which has moved a proposal for clearance by the finance ministry, has suggested that the maximum subsidy of 35% should be given to pure electric vehicles, while a 25% benefit should be provided for plug-in vehicles that can drive for at least 15km at one go. (The Economic Times ,July 2014)

It is hard to find any reason why Government should not support electric two-wheeler industry. Government can extend whatever the support it is giving to four-wheeler electric cars to bikes too, including charging station. Electric bikes and cars can use the same charging station.

As out of the 65 manufacturers a couple of years ago there are only 10 full fledged electric vehicle manufacturers left in the country. The danger is that if NEMMP 2020 further gets delayed, another half will go.

The lack of Government subsidy for the industry has perhaps ignited the idea of Mahindra manufacturing GenZe-electric two wheeler for the US market:- an electric two-wheeler in a country of fast cars, cheap gas, and wide roads.

Table 2: EV Players who are planning to enter Indian market

Players	Description
Renault	• It is planning to enter the electric vehicle segment in India by 2015. Renault plans to bring cars to India first as completely build units and may later set up local assembly of manufacturing
Pininfarina	• Italy-based company is planning to launch an electric car in the Indian market by 2014. The battery driven car will run for 250 kms in one charge.
Mitsubishi Motors	• It has already launched Mitsubishi Innovative Electric Vehicle (MiEV) in Japan and Hong Kong and plans to launch an electric car in India soon.

Globally, countries which have taken the lead in developing green vehicles (US, Germany, Israel, China, France and Brazil), have all seen significant government involvement. Furthermore, the availability of investments in unproven technologies, as well as clusters of support industries, have ensured that the sector has sustained innovation. (KPMG 2010). Is Indian government doing enough to boost sales of Electric Vehicles in India ? Also what is India's answer to reasonably priced , cleaner and sustainable personal mobility solution ?

Figure 3 : Incentives to EV owners in different countries

Rolling out the red carpet
Several countries offer wide-ranging incentives to EV owners.

United Kingdom	<ul style="list-style-type: none">• Free parking in some areas.• Certain areas in London are EV-only zones.• Exempt from £8 per day congestion tax.
Japan	<ul style="list-style-type: none">• Direct subsidy of \$2,600.• Up to 50 per cent subsidy of incremental cost of clean energy vehicles.
Norway	<ul style="list-style-type: none">• No import duty on Reva.• EVs can drive in bus lanes.• No congestion charge on city toll ring road.• Free parking in government-owned parking spots.• Cheaper insurance for EVs.
France	<ul style="list-style-type: none">• €2,000 subsidy to each EV buyer.• Free parking for EVs.• No tax on electricity used for charging an EV.• Lower road tax.
United States	<ul style="list-style-type: none">• \$4,000 subsidy to each EV buyer.• Preferential parking areas.• Subsidy on the installation of charging infrastructure.
Italy	<ul style="list-style-type: none">• €1,800 subsidy to each EV buyer.• Free parking facilities in certain cities.• No road tax for first five years of ownership.
Malta	<ul style="list-style-type: none">• Removed 50.5% registration tax on cost, insurance and freight.• No \$55 charge for entering the capital city.• 15% tax rebate (up to \$1,300) on 18% VAT.

Source: Reva Electric Car Company

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