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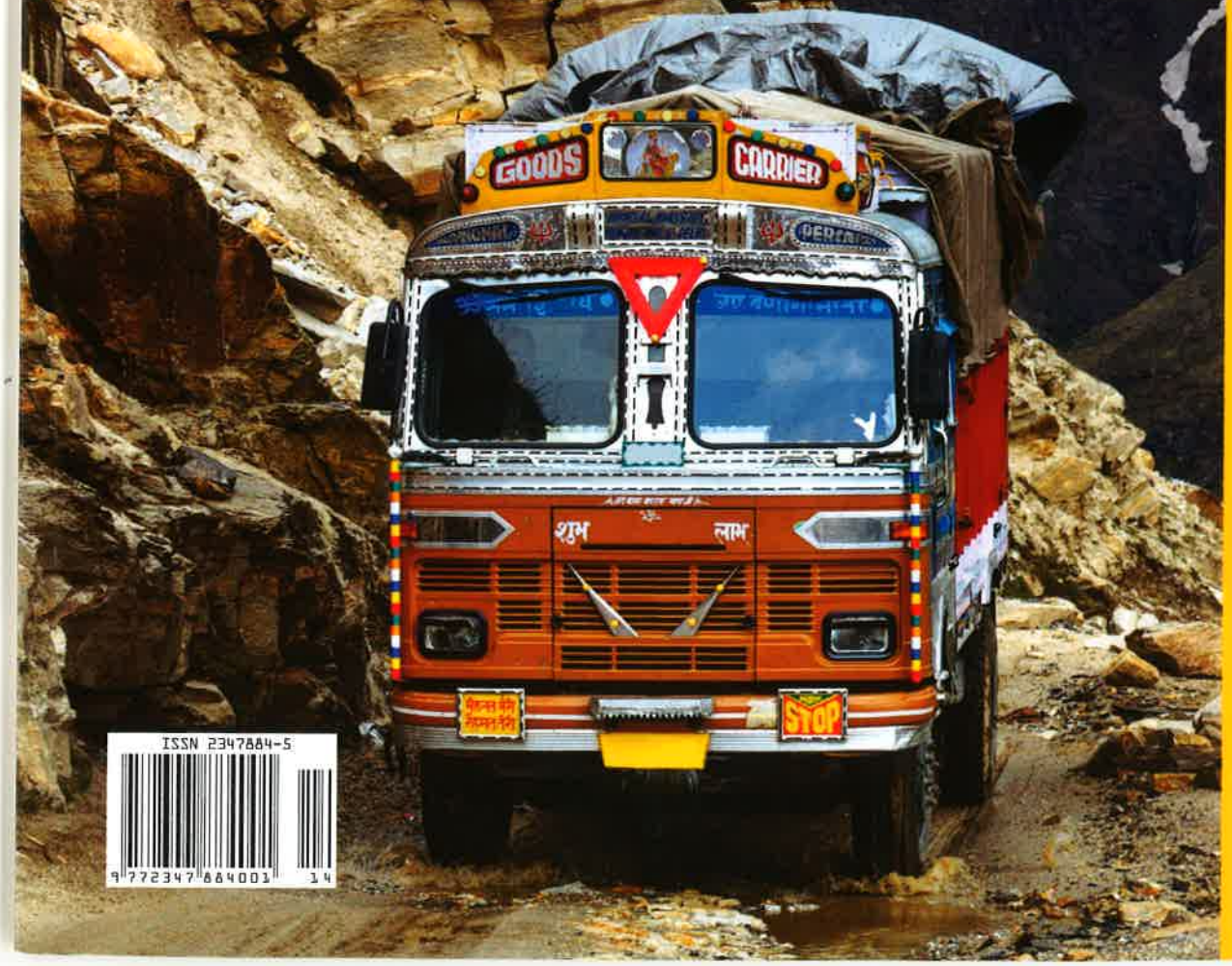
THE CARRIERS

TRANSPORT PERSPECTIVES



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The share of petroleum consumed by the transport sector in India for 2011-12 is 8 per cent.

According to the International Council on Clean Transportation, global electric vehicle sale was highest for Norway followed by Netherlands for 2013.

Electric Vehicles Vs India's Energy Security

EMISSION SCENARIOS

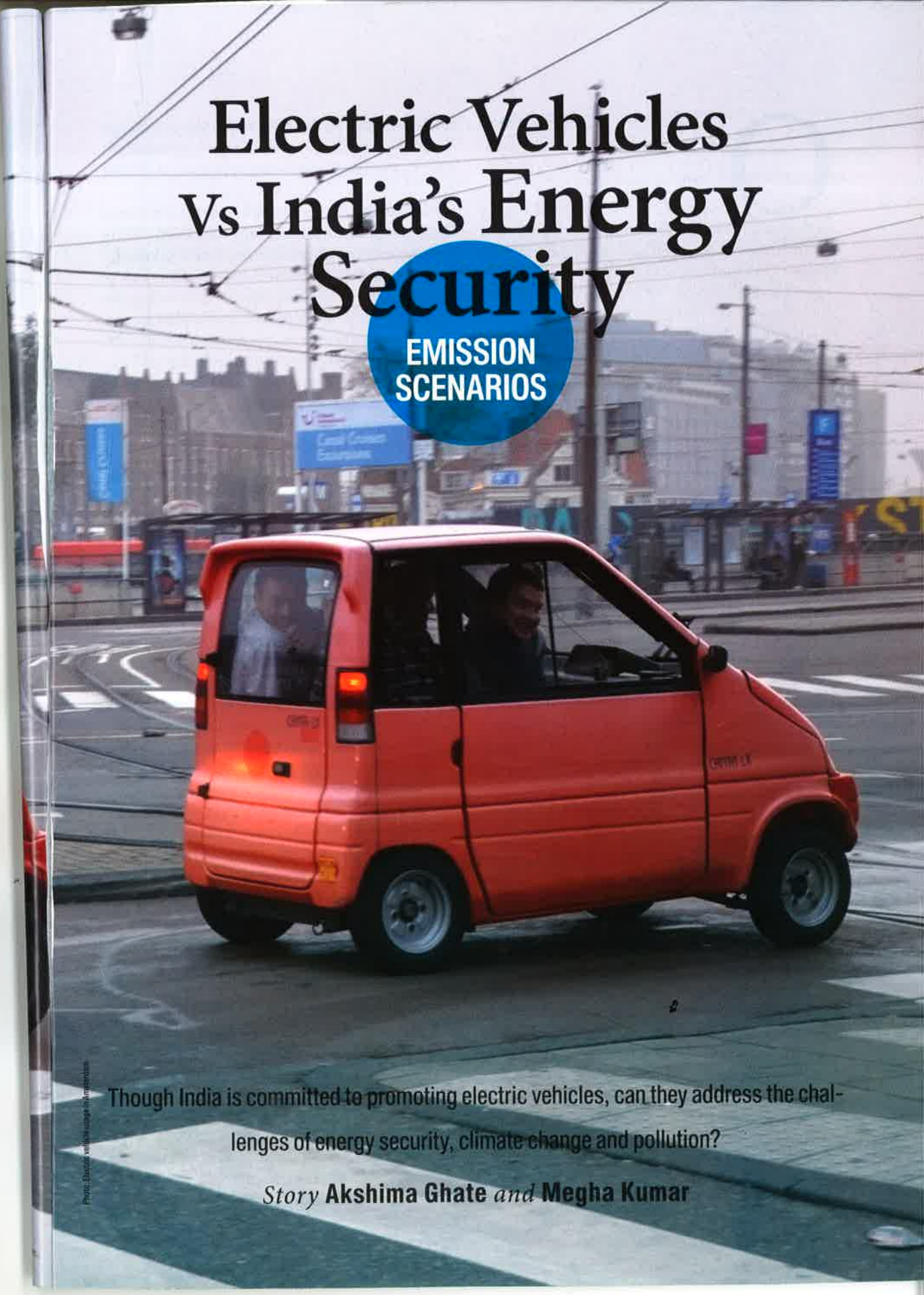

Photo: Electric vehicle on display in Amsterdam

Though India is committed to promoting electric vehicles, can they address the challenges of energy security, climate change and pollution?

Story **Akshima Ghate** *and* **Megha Kumar**

Over the past few decades, the world has started looking at technologies that can reduce dependence on oil. Almost 95 per cent of the transport sector's end-use energy needs globally are oil driven and diversification of fuel technologies has been near insignificant when compared to the scale of the sector's energy use.

India is no different—98 per cent of the sector's energy needs are met by petroleum products (S Sundar *et al.*, 2011, 'Transport and energy: The Indian perspective', Transport Moving to Climate Intelligence, Springer) and use of alternative fuels is minimal and that too primarily in the railways sector. Road transport is almost entirely dependent on petroleum products and to some extent on natural gas. The country is witnessing an unprecedented growth of motor vehicles, a trend that is expected to become even more rapid in the next few decades. It is in fact projected that India's transportation energy use will grow at the fastest rate in the world in the next three decades (International energy outlook, 2013, US Energy Information Administration), a trend that a highly oil import dependent and a fast growing economy like India would certainly want to wish away. The questions therefore are—can we diversify the fuel mix, specifically in the road transport sector in India, and how challenging it would be. Most governments, including India, are today looking at electric vehicles as a solution. India is amongst one of the first movers in the developing countries with a clear road map for introduction of electric vehicles (EVs) in the next one decade.

The Indian government launched the National Electric Mobility Mission Plan (NEMMP) 2020 in 2013, which promotes adoption of electric vehicles in the country with an aim to address energy security, climate change and pollution issues. In order to increase the penetration of EVs, the plan focuses on creating consumer acceptability and developing infrastructure to support ownership and use. It also emphasises on developing technology and creating local manufacturing capability, and targets ambitious penetration levels at 14-16 per cent (5-7 million vehicles) of the total vehicular fleet by 2020. Even before the launch of NEMMP, the Indian government had been making efforts to incentivise EVs. In 2010, the Ministry of New and Renewable Energy launched an Alternate Fuels for Surface Transportation (AFST) Programme which provided financial assistance to EV consumers. Though this period witnessed high sales, the EV market experienced a sharp downfall as soon as the subsidy was withdrawn in 2012, indicating the need for demand side incentives.

For any significant impact of EVs to be realised, it would be important to assume that they will make a sizeable penetration into Indian markets. This, however, remains questionable till the cost of EVs are brought within the reach of consumers, as choices are dominated by value for money in the Indian market. A sizeable share of Indian car buyers demand powerful and fuel efficient vehicles at 'competitive' prices. The upfront cost of the vehicle is hence one of the most important purchasing criteria and the concept of total cost of ownership (TCO) is highly undervalued. Similar behaviour is also exhibited by consumers in the most evolved EV markets like Norway, where EVs constitute more than 0.5 per cent of the country's vehicular fleet (E Figenbaum *et al.*, 2013, 'Electromobility in Norway: Experiences and opportunities with electric vehicles', Institute of Transport Economics, Oslo).

The Norwegian government gives fiscal benefits like subsidy on the upfront cost of the car (to the tune of 1000 Euros), exemptions from tolls, etc., are combined with non-cost benefits. Under the 'Ten cities, thousand vehicles plan', the city of Hangzhou is offering its citizens a subsidy of approximately 20,000 USD for the purchase of a battery powered EV and free electricity for first three years or for 60,000 km (W Tao, 2013, 'Recharging China's electric vehicle policy', Policy Outlook, Carnegie-TSinghua Center for Global Policy). To promote EVs, Beijing is exempting such vehicles from its strict license registration lottery system, hence focusing both on cost and non-cost benefits.

Choice of consumers to opt for EV technology will also be determined by the expected performance and charging requirements. The EV's limited mobility range and long charging duration discourages buyers. This concern is being addressed by some of EV manufacturers—Mahindra Reva in India offers a technology wherein the commuter can contact a service centre to release the stored reserve charge in the battery in case of an emergency, allowing the driver to reach a nearby charging point.

Though EVs have been in the market for a few decades now, the technology is still considered nascent as against the internal combustion engine (ICE) vehicles. The battery, the most crucial part, has not witnessed significant progress in technology (A Sardar *et al.*, 2011, 'The quest for electric vehicle batteries with high specific energy', Auto Tech Review); developing cost effective batteries for EVs is emerging to be a challenge. Lead-acid batteries, still in use, are slowly being replaced by lithium-ion (li-ion) which are cleaner, lighter and have a longer life cycle. Thus in the present context li-ion is predicted to be the prime technology for batteries. According to a 2012 Pike research report on electric bicycles, the global penetration of Li-ion battery will grow from 6 per cent in 2012 to 12 per cent in 2018 and a gradual decline in its cost is expected with large scale production. Internationally a number of other battery systems are being tested, like lithium air, metal air batteries, etc. But with limited industrial and research capacity in India, the chances of leap frogging from lead acid to innovative battery systems in a cost effective manner seems difficult.

Another hindrance is the absence of public charging infrastructure in India. This, however, may not be a very significant barrier as examples exist wherein countries have succeeded in increasing the penetration of EVs both with and without extensive public charging infrastructure in place. UK, which has 1 EV/12600 people, has an extensive public charging infrastructure ('Pathways to high penetration of electric vehicles', 2013, Element Energy Ltd, University of Aberdeen). On the other hand, Norway, which has 1 EV/ 238 people, has minimal public charging facilities (*ibid*).The need for public charging infrastructure would depend on the Indian city's characteristics; cities with plotted development may find it easier to promote charging at home while those with dense and high rise residential units may have to retrofit parking areas to provide for charging points. Infrastructure for EVs in public spaces like commercial centres, institutional and office areas, etc., would also be required.

Though India is committed to promoting EVs, the key question is whether EVs can address the challenges of energy security, climate change and pollution. It is thus pertinent to look at the availability of electricity to power EVs. The recent example of Tamil Nadu, where power outages have almost driven EVs out of the market ('Electric motorbikes in India: Six questions for the CEO of Hero Electric', 2013, Forbes), highlights the importance of availability and quality of power. The NEMMP indicates that the electricity load on EVs would be met and estimates a power requirement of 600 MW for electric two wheeler and 15 to 225 MW for electric cars by 2020.

If we were to achieve a considerable share of EVs in our vehicle fleet it may be able to address a key concern in our cities—air pollution. All electric or battery electric cars have zero emissions as compared to petrol and diesel which release harmful substances like carbon monoxide (CO), nitrogen oxide (NOx), particulate matter (PM), etc. There are, however, emissions of harmful pollutants at the point of electricity production which cannot be neglected while comparing the harmful emissions from use of petroleum dependent cars and electric cars. As per BS-IV emission standards in India, gasoline cars cannot emit more than 1 g CO, 0.1 g hydrocarbon (HC) and 0.08 g NOx per km; emissions on account of generation of electricity required to run 1 km of an electric car, assuming that the electricity is produced in thermal power plants, would be in the range of 0.72 g sulphur dioxide (SO_2)and 0.44 g NO. As can be observed, the amount of NO emitted from energy required to fuel an electric car is more than a gasoline car. Also, SO_2 emissions cannot be neglected given its harmful impacts. It is therefore clear that while electric vehicles may solve the pollution problem in cities, their use of electricity leads to pollution at locations away from cities. The problem however can be addressed by using clean electricity in EVs, an advantage over ICE cars given that there will be a choice to fuel them from clean sources.

However, there is no clear understanding of energy security, as there is a dilemma whether we will simply effect transition from oil imports

Electric two wheelers have reportedly witnessed a growth of 20 per cent in India. The Indian government targets use of 5-7 million EVs by 2020 including 3.5-5 million two wheelers ('National electric mobility mission plan 2020', 2012, Ministry of Heavy Industries and Public Enterprise).

to lithium imports if we are to replace our ICE vehicles with EVs. Lithium is concentrated in very few geographical locations around the world. As per the 2010 paper by Bethel *et al.* 'Is lithium the 21st century's oil' by Sinolatin Capital—Argentina, Bolivia and Chile control more than 75 per cent of the lithium reserves; any instability in this region could lead to large fluctuations in lithium prices. As more than 7 per cent of the global transportation need would be catered to by EVs by 2020, this would put high pressure on lithium ('Electric vehicle market forecasts for light duty hybrid, plug-in hybrid, and battery electric vehicles: 2013-2020', 2013, Navigant Research). Being hailed as the 'energy source of the future', various countries and auto manufacturers have already started forging partnerships and alliances with lithium rich countries. Some experts contradict this and emphasise that due to high reuse potential of lithium, there would never be a shortage (R Evans, 2008, 'An abundance of lithium', www.worldlithium.com). However, going by the present day technology, lithium extraction from used batteries is a highly uneconomical process. Typically, the vehicle batteries contain insignificant percentage of lithium carbonate by weight and the cost of lithium is only 3 per cent of the cost of production of li-ion battery (A Kumar, 'The lithium battery recycling challenge', www.waste-management-world.com).

Endnote

It can be concluded that in the current context, EVs appear only as a partial solution to our quest for clean mobility, climate change mitigation and energy security, with several critical questions on their contribution to these issues being unanswered. It is essential that as a nation we look into these questions and evaluate holistically while developing a road map for introduction of EVs. One thing, however, is clear that if EVs are powered from renewable sources, most of these questions would be addressed and would easily justify our move towards electric technology. Our approach to enhancing EV penetration in the country should hence imbibe powering EVs from clean electricity. GY

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