India's electric vehicle success story will ride on two wheels

Adoption of electric two-wheelers will need cheaper lithium-ion batteries, increasing charging speed and improving charging infrastructure

SHASHANK SRIPAD
VENKAT VISWANATHAN

The year 2018 was the year for electric cars. Cumulative electric vehicle (EV) sales in China topped 1 million, and the Tesla Model 3 became the best-selling premium car, delivering over 1.4 million vehicles in the year. According to the latest Global Electric Vehicle Outlook by the International Energy Agency, China has around 250 million electric two-wheelers, with annual sales of 30 million.

This progress appears extremely promising as there are close to a billion electric two-wheelers in circulation in the Association of Southeast Asian Nations, China and India.

However, electric two-wheeler adoption is almost exclusively limited to China. Amidst all of this, there is an even more impressive story, one that is not often told. As highlighted in an article by Aashish Bhat, CEO, NTTI Aayog, he also detailed that by electrifying all the two-wheelers in use, India can avoid 15% of the total transportation emission and more importantly, about 30% of particulate matter, curbing air pollution.

This raises the question of what makes China different from its neighboring countries in Asia. Two factors are highlighted for this success story in China: number one, electric two-wheelers are a part of the landscape; two, policies place severe limits on the use of petrol two-wheelers in the city centres. In order to write an EV success story for India, it is very important to electrify two-wheelers, which are about three-quarters of the transportation fleet, as noted by Amitabh Kant, CEO, NITI Aayog. He also detailed that by electrifying all the two-wheelers in use, India can avoid 15% of the total transportation emissions and more importantly, about 30% of particulate matter, curbing air pollution.

The electric scooter is around four to six times more efficient than a petrol scooter. Three-fourths of the transportation fleet, as noted by Amitabh Kant, CEO, NITI Aayog. He also detailed that by electrifying all the two-wheelers in use, India can avoid 15% of the total transportation emissions and more importantly, about 30% of particulate matter, curbing air pollution.

The electric scooter is around four to six times more efficient than a petrol scooter.

This raises the question of what makes it so difficult to make an electric two-wheeler competitive with petrol vehicles. In order to answer this question, we first go back to some high school physics.

To move an object, such as a vehicle and propel it forward, the propelling force must overcome the opposing forces. In a vehicle, the propelling force is produced by the energy source which could be petrol, diesel, natural gas (CNG) or electricity within a device like an engine or a motor. There are four kinds of opposing forces acting on a vehicle, the first is aerodynamic force – the force exerted by an air biker, the second is friction between the tyres and the road, which wears the tyres out over time. The third is overcoming gravity while travelling on a road, and the fourth required goes up an incline road. The last is the force required to overcome inertia, which keeps objects at rest or in motion unless a force acts on them, so the vehicle will remain at rest unless a part of the propelling force pushes it forward.

In the real world, a conventional scooter's 'mileage' is about 50-70 km for a litre of petrol, which can be interpreted to be about 135-190 watt-hours for every kilometre (1000 watt-hours is one unit in a monthly electricity bill).

By electrifying all the two-wheelers, India can avoid about 15% of the total transportation emission. On the other hand, if the same scooter is electric, then it would need about 25-40 watt-hours (equivalent to running a modern LED tube light for about two hours). The electric scooter is around four to six times more efficient than a petrol scooter. The electric scooters are able to accomplish this because they have two things that are in their favour: the batteries and electric motors are much more efficient than petrol engines and, electric scooters have a trick up their sleeve called regenerative braking. Regenerative braking allows running the motors in 'reverse', storing energy back into the battery pack while decelerating.

Cost per km For the price-conscious Indian, it is important to quantify how much this translates to in cost per km of driving. A litre of petrol costs about Rs 70 and the conventional scooter operates at about 70-100 km per litre. For an electric two-wheeler, with an electricity price of around Rs 6 per unit, it would cost about Rs 40 per 100 km, which is significantly lower. Bloomberg New Energy Finance estimates that the total cost of owning and operating electric two-wheelers in 2020 would be about Rs 12 per km, which is on par with petrol vehicles.

As a result of this, the demand for electric two-wheelers is expected to increase at a CAGR of 30% per year, which will have a significant impact on the overall auto sector and the economy as a whole.

Expensive batteries Lithium-ion batteries cost over Rs 100,000 for every kilowatt-hour. This means that for a 100-km electric two-wheeler, the battery cost itself will be around Rs 4,000,000 to Rs 5,000,000, which is close to the average retail price of petrol two-wheelers today. A second challenge remains which is related to “re-filling” the tank of an electric scooter. This requires an electric scooter's battery to be charged and this can take of the order of an hour or more today. The slow charging time of Li-ion batteries remains a frustration for many cell phone users, and the same issue persists for electric scooters. Li-ion batteries today cannot be charged safely and quickly.

The final question is where should one go to charge an electric scooter. Charging infrastructure is sparse today but there is a strong commitment to improving this. An open question remains on how to strategically place the chargers such that it can lead to widespread use and adoption.

One bright spot within all of this is that it is possible to charge an electric scooter at home with a conventional plug outlet in a couple of hours.

In the recent Interim Budget of 2019, the then Finance Minister Piyush Goyal stressed on the need to switch to EVs powered by renewables to reduce oil imports and combat climate change. The electrification success story in India hinges on electrifying two-wheelers which will require lowering costs of Li-ion batteries, increasing charging speed and improving the charging infrastructure.

Shashank Sripad is a PhD candidate at Carnegie Mellon University and Dr. Venkat Viswanathan, assistant professor of mechanical engineering, Carnegie Mellon University.