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Electric Vehicles in the Indian Market

Armaan Jain
armaan6657@gmail.com
Sanskriti School, New Delhi, Delhi

ABSTRACT

The Indian automotive industry is undergoing a significant transformation with a growing emphasis on sustainable and environmentally friendly transportation solutions. Electric vehicles (EVs) have emerged as a promising alternative to conventional internal combustion engine (ICE) vehicles. This research paper explores the current landscape of electric vehicles in the Indian market, focusing on their adoption, challenges, and future prospects. This research paper concludes whether or not Revv (a self-drive car rental business operational all across India) should switch to EVs from traditional ICE vehicles.

Keywords: *Electric Vehicles, EV Adoption, Indian Market, Challenges, Future Prospects, Infrastructure, Policy Framework, REVV*

Part 1
Introduction

This research paper will undertake a deep analysis of the past, present and future affairs related to electric cars in the Indian market. The purpose of this investigation is to ascertain whether electric cars should be added to Revv's fleet of cars.

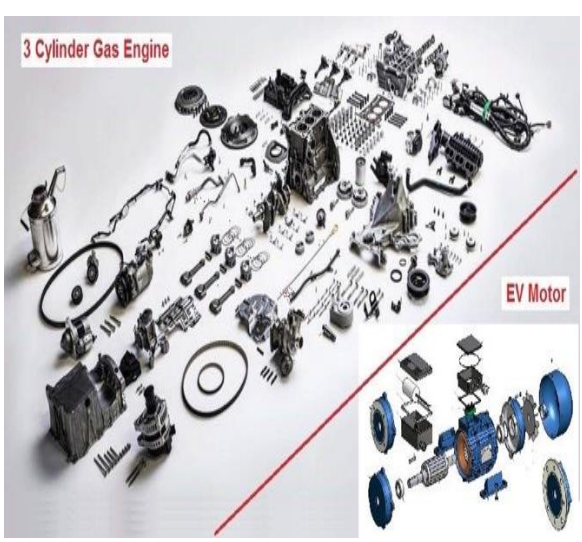
ICE VS EV

In an internal combustion engine (ICE), the ignition and combustion of the fuel occurs within the engine itself. ICE vehicles have a high specific energy fuel, while EVs (Electric Vehicles) have a low specific energy of the battery.

ICE vehicles, however, are not environment friendly as they emit large amounts of greenhouse gases. The transportation industry is the second leading industry in emitting greenhouse gases contributing a large 29%. EVs, on the other hand, have no tailpipe emissions and hence, are relatively much more environment friendly.

ICE vehicles, on being fueled once, can go more than 600 kms. Fueling an ICE vehicle takes no longer than 5 minutes. Charging an EV can take anywhere between 30 minutes and 8 hours and most EVs can drive for around 250 km before needing to be recharged.

The fuel tank in ICE vehicles is much smaller compared to the battery of an EV. The batteries in an EV are also much heavier as compared to the fuel in an ICE vehicle.



ICE vehicles, as shown above, have many more moving parts than EVs. So, ICE vehicles have a higher maintenance cost than EVs. ICE vehicles also produce much more sound as compared to EVs.

How EV batteries have developed through the years

Lead Acid- Lead-acid batteries were the oldest, cheapest and most commonly used batteries in the past. They use around 30-40% of the battery capacity. They have a low specific energy of 30–50 W·h/kg. The charge cycle is between 80-85%. Lead-acid batteries have low specific energy, poor cold-temperature performance, and short calendar and cycle life that impede their use. Additionally, lead-acid batteries self-discharge at a high rate.

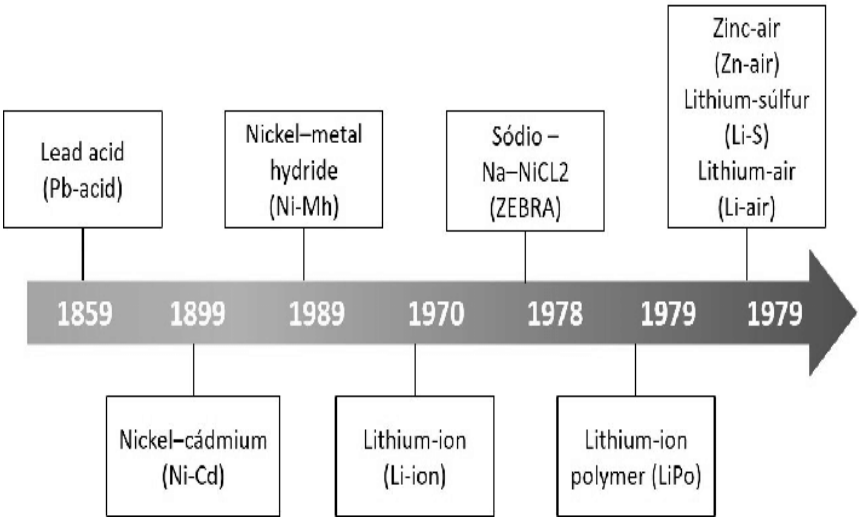
Nickel-metal hydride- Nickel-metal hydride batteries are now considered a relatively mature technology. While less efficient (60–70%) in charging and discharging than even lead-acid, they have a specific energy of 30–80 W·h/kg, far higher than lead-acid. When used properly, nickel-metal hydride batteries can have exceptionally long lives, as has been demonstrated in their use in hybrid cars.

Zebra- The sodium nickel chloride or Zebra battery uses a molten sodium chloroaluminate salt as the electrolyte. A relatively mature technology, the Zebra battery has a specific energy of 120 W·h/kg. Since the battery must be heated for use, cold weather does not strongly affect its operation except for increasing heating costs. Zebra batteries can last for a few thousand charge cycles and are non-toxic. The downsides to the Zebra battery include poor specific power (<300 W/kg) and the requirement of having to heat the electrolyte to about 270 °C (518°F), which wastes some energy, presents difficulties in long-term storage of charge, and is potentially a hazard.

Lithium-ion- Lithium-ion batteries were initially developed and commercialised for use in laptops and consumer electronics. With their high energy density and long cycle life, they have become the leading battery type for use in EVs. The downside of traditional lithium-ion batteries includes sensitivity to temperature, low-temperature power performance, and performance degradation with age.

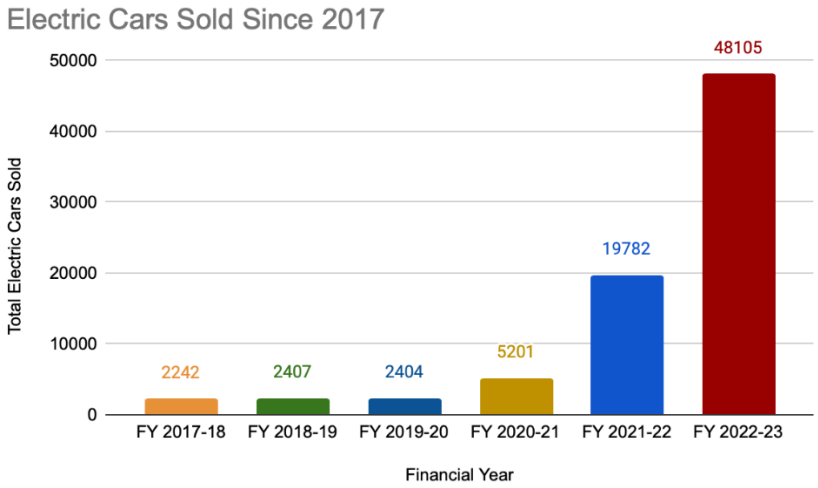
Recent EVs are using new variations on lithium-ion chemistry that sacrifice specific energy and specific power to provide fire resistance, environmental friendliness, rapid charging and longer lifespans. Lithium iron phosphate lasts at least 10 years and more than 7000 charge/discharge cycles, and LG Chem expects their lithium-manganese spinel batteries to last up to 40 years. The charge cycle is 90%. One lithium-ion battery pack gets a full charge in less than 2-3 hours apart from the fast-charging technology that cuts the time significantly.

Sodium-ion- Sodium-ion batteries have an energy density between 100 Wh/kg to 120 Wh/kg. The technology targets applications in the fast charge and discharge markets. Power density is between 2 and 5 kW/kg, allowing for a 5 min charging time. Its lifetime is 5000+ cycles and has a battery capacity of 80%. Though Sodium-ion batteries have several advantages over lithium-ion batteries, including cost, safety, temperature range, energy density, lifespan, and potential for environmental sustainability, their lower energy density and short cycle life make them incomplete.



Growth in sales of electric cars through the years

Since FY 2017-18 till date, there has been substantial growth in the sales of electric cars. Car sales were steady from FY 2017-18 to FY 2019-20 at around 2400 cars. FY 2020-21, however, saw a growth of 116.3%. The sales of electric cars have continued to increase since then. In FY 2021-22, there was an even greater increase of 280.3% with a large number of 19,782 total cars sold. In the FY of 2022–23, there was an increase of 143.1% at 48,105 total cars sold. The history of sales of electric cars has shown a positive sign of growth.



(All data has been taken from VAHAN Portal)

Cost comparison

When we draw a cost comparison between EVs and ICE vehicles, many factors must be thought of like the upfront cost, depreciation of the vehicle, the cost of fuel and energy, the cost of maintenance and the associated taxes. .

Depreciation- EVs generally experience depreciation from the minute of purchase. The most significant impact of depreciation is experienced within the first 3 years of purchase. EVs lose up to 52% of their value in the first 3 years as compared to 39.1% in ICE vehicles.

Cost of fuel and energy- Cost of charging an EV at home will increase the electricity bill but the increase can vary from the time of the day to the area of living. The cost of charging is usually between ₹8-10 per unit. It will take around 28-30 units for the car to fully charge. So, the price can vary from ₹224 to ₹300. Most cars would drive up to 250 km on a full charge.

An average car tank can hold between 45 and 65 litres of petrol and it costs an average of ₹100 per litre of petrol. Therefore, it would cost between ₹4500 and ₹6500 to fill up a tank. Most petrol cars would drive up to 600 kms.

So, if an electric car and a petrol car were to cover the same distance, the cost to charge an electric car would be cheaper than the cost to fuel a petrol car.

Maintenance- EVs have an average of 11% lower cost as compared to ICE vehicles. The number of moving parts in an EV is much less than that of an ICE vehicle. Despite this, both types of cars require general maintenance which includes brakes, tyres, windscreen and general wear and tear.

Cost of taxes- To promote the use of EVs in India, the government has decided to exempt EV owners from taxes. EV buyers can claim up to ₹1.5 lakh income tax deduction on the interest paid for vehicle loans under section 80 EEB of the IT Act. ICE vehicle owners have to pay a certain amount of tax depending on their car model. This tax can vary from 12% to 50%. Factors that affect the tax rate include the length of the car, the type of car engine (ie. diesel, petrol, CNG, etc.) and the mileage of the car (this depends on the Cubic Capacity of the car engine).

Upfront Cost- The upfront cost of an EV is higher than an ICE vehicle. As shown in Table 1, the cost of a Tata Nexon Petrol model is almost Rs. 5 lakhs cheaper than the same EV model of the car.

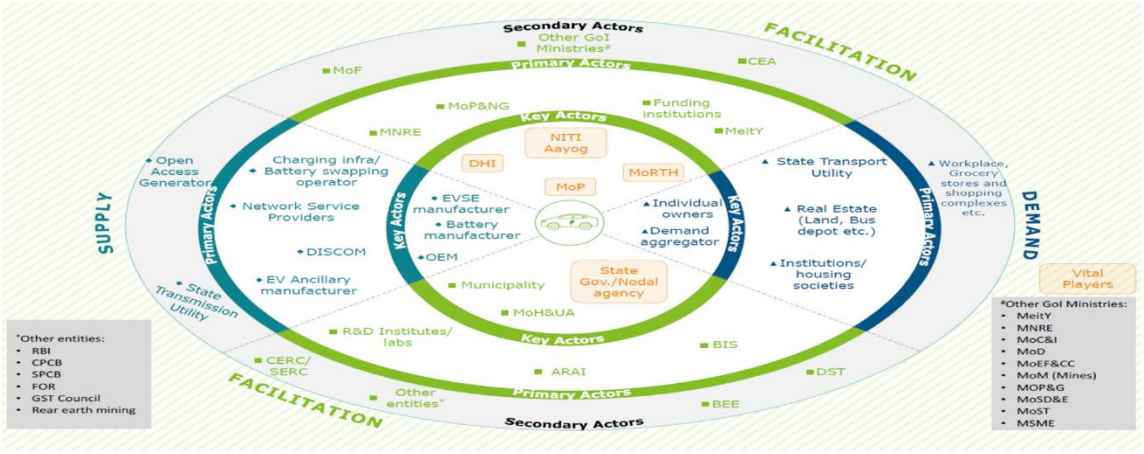
Car Model	Showroom price for car	Rate of petrol/ electricity	Efficiency	Per km cost	Total run/ month	Monthly expenses
Tata Nexon Petrol	Rs. 10,67,405	Rs. 90.56/km	11 kmpl (assumed)	Rs. 8.23	1000 kms.	Rs. 8230
Tata Nexon EV Prime	Rs. 15,34,957	Rs. 4.5/kWH	250 kms. (assumed)	Rs. 1.83	1000 kms.	Rs. 1830

Table 1

What has changed?

As compared to the past, there has been a dramatic change in EVs. Electric cars are much cheaper than they were a few years ago. They now have a driving range much more than before. The range of an electric car in 2018 was between 100 and 200 kms. whereas the same is between 250 and 400 kms. currently. The choice of available electric cars has changed too. In 2018, there were less than 10 different electric car models. As of today, there are over 15 models and 41 model launches are expected by 2025.

Current overview of the EV ecosystem in India

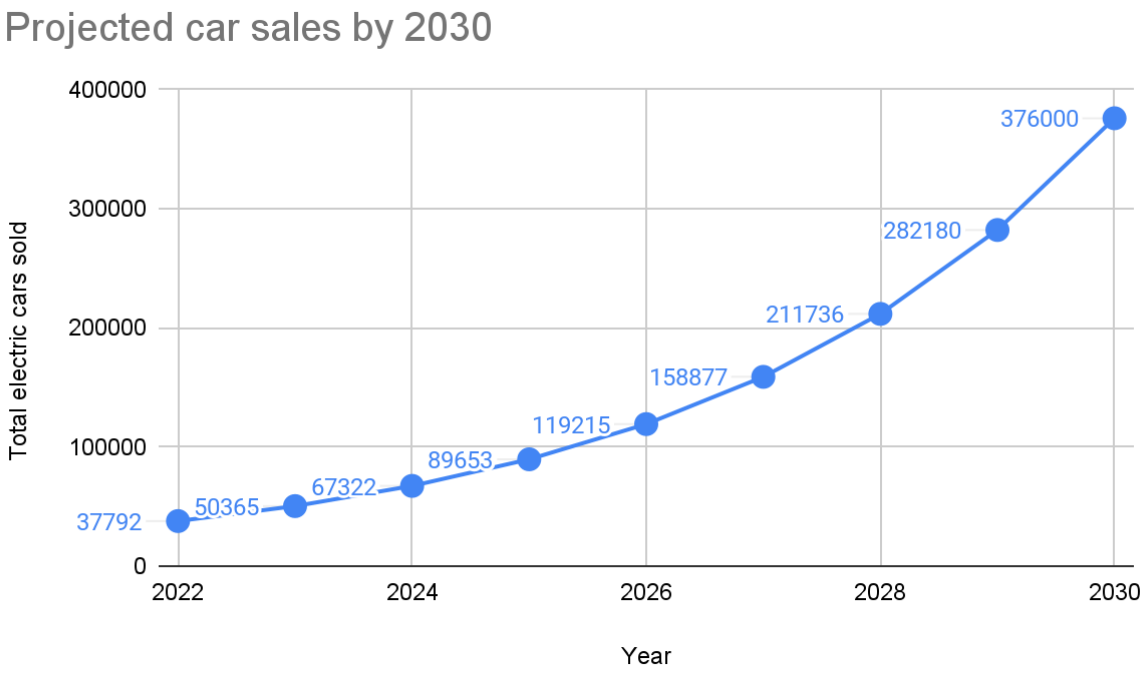


Part 2

Future of electric cars

The number of electric cars in the market was 37,792 units at the end of CY 2022. The projected CAGR (compound annual growth rate) is 33.3% thereby reaching 3,76,000 units by the end of CY 2030. In the first

quarter of CY 2023, there were a little more than 10,000 units sold. If growth continues at this rate, the predicted CAGR would be much lesser as compared to the real-time CAGR.

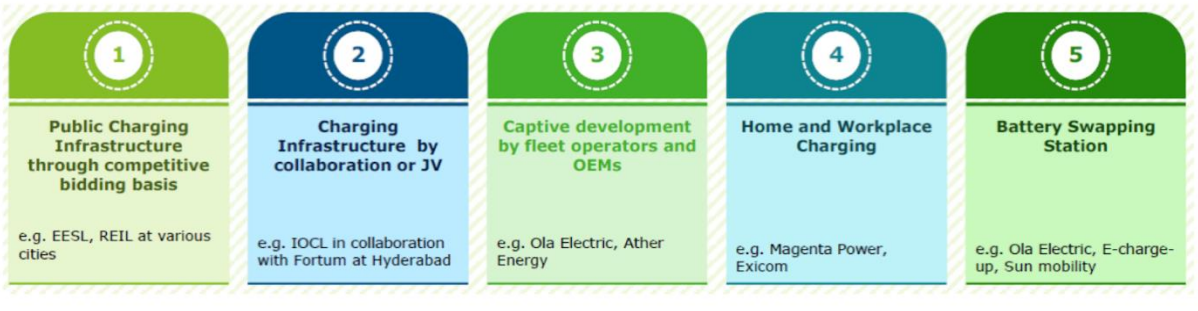


Future of charging stations

Electric vehicles are still a long way from becoming the mainstream transportation mode in India but the EV market has shown increasing demand. Electric vehicles have the potential to transform the transportation sector worldwide. Electric vehicles in all categories are two, three or four-wheelers and will continue to increase by 2030.

With increasing research, EVs can perform at par with conventional vehicles but a major challenge for the electric transport ecosystem is EV charging infrastructure. Adequate charging infrastructure is required for the rapid adoption of electric vehicles. The lack of a robust charging infrastructure is one of the main reasons behind the low rate of penetration of EVs in India. One of the main challenges in the growth of EVs is the lack of charging infrastructure throughout the country.

Development of charging infrastructure can take many routes, as illustrated in the image below:



Tata Group has recently signed a deal on building a lithium-ion cell plant with an investment of $1.58 billion as a part of its effort to create its own electric vehicle supply chain. The plant would have an initial manufacturing capacity of 20 GWh which can be doubled in the second phase of expansion. The plant will be located in Gujarat. Officials of the Government of Gujarat say that the plant will go a long way in contributing to India's shift towards EVs and the ecosystem.

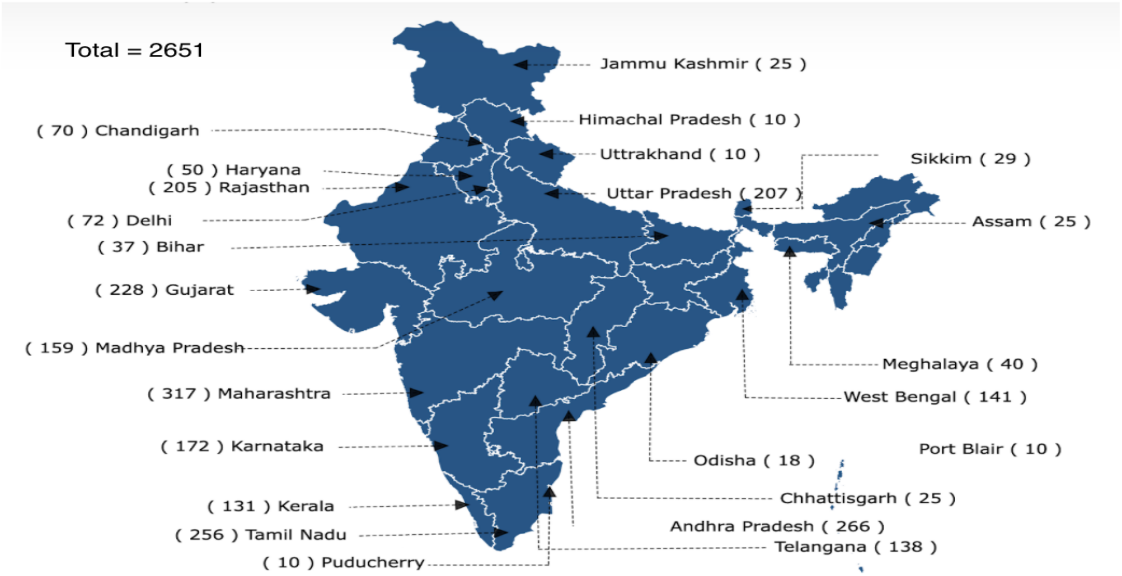
Government of India's role

The government's ambition is to have EV sales accounting for 30% of private cars by 2030 as there is an urgent need to decarbonise the transport sector. If electric cars expand to 40% by 2030, India would be able to cut it's crude oil consumption by 156 million tonnes which is worth Rs 3.5 lakh crore.

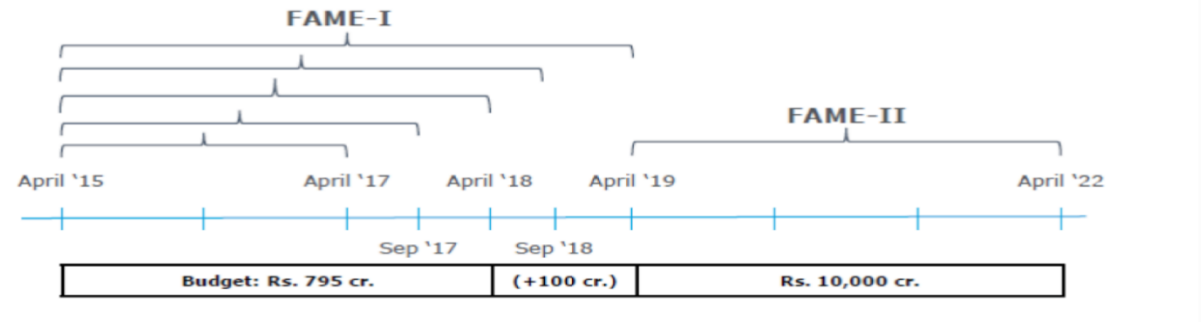
The Road Transport and Highways Minister pointed out that NITI Aayog has inspired 25 States to come up with EV policies, out of which 15 have already announced State EV policies in the EV mission.

By 2030, India will require approximately 800 GWh of batteries to be able to attain 30% EV adoption. To achieve this, the country is accelerating the plans to manufacture lithium-ion cells, anticipating more than 7.5 billion USD in potential investment and USD 2.3 billion in government subsidies.
The Government wants India to be a 100% electric vehicle nation in terms of the new vehicle sales by the year 2030. Under the new plan of the government, every car which will be sold in India from 2030 onwards will be electric. For that to be possible, the government has to build EV infrastructure all around the country at a rapid pace.

Current state of charging points infrastructure in India:



FAME, or Faster Adoption and Manufacturing of (Hybrid and) Electric vehicles, is currently India's flagship scheme for promoting electric mobility. It was launched by DHI in 2015. Currently, in its 2nd phase of implementation, FAME-II is being implemented for a period of 3 years, eff. 1st April 2019 with a budget allocation of Rs. 10,000 Cr. which includes a spillover from FAME-I of Rs. 366 Cr. The Department of Heavy Industries has also sanctioned 2636 charging stations in 62 cities across 24 States/UTs under the FAME India scheme phase II.



In India, the Electric Highway trial run is a pilot project aimed at evaluating the feasibility and benefits of electrifying highways. This was conducted on the NH48 (Delhi-Jaipur Highway) and the NH2 (Delhi-Agra Highway). The trial run involves equipping selected stretches of highways with charging infrastructure at regular intervals, enabling EVs to recharge their batteries while on the move. These charging stations employ fast-

charging technologies, allowing EVs to quickly replenish their battery levels during long-distance journeys. To facilitate the Electric Highway trial run, India is investing in the development of robust charging infrastructure along the designated highways. These charging stations are strategically placed to ensure that EV owners have easy access to power, whenever needed.
Additionally, the government is collaborating with public and private stakeholders to establish standardised charging protocols, making it convenient for EV users to charge their vehicles regardless of the vehicle brand or model. The availability of a robust charging infrastructure will boost consumer confidence and alleviate range anxiety, making EVs a more attractive option for potential buyers. This, in turn, will accelerate the transition from conventional internal combustion engine vehicles to cleaner electric alternatives.

Part 3
What is Revv?

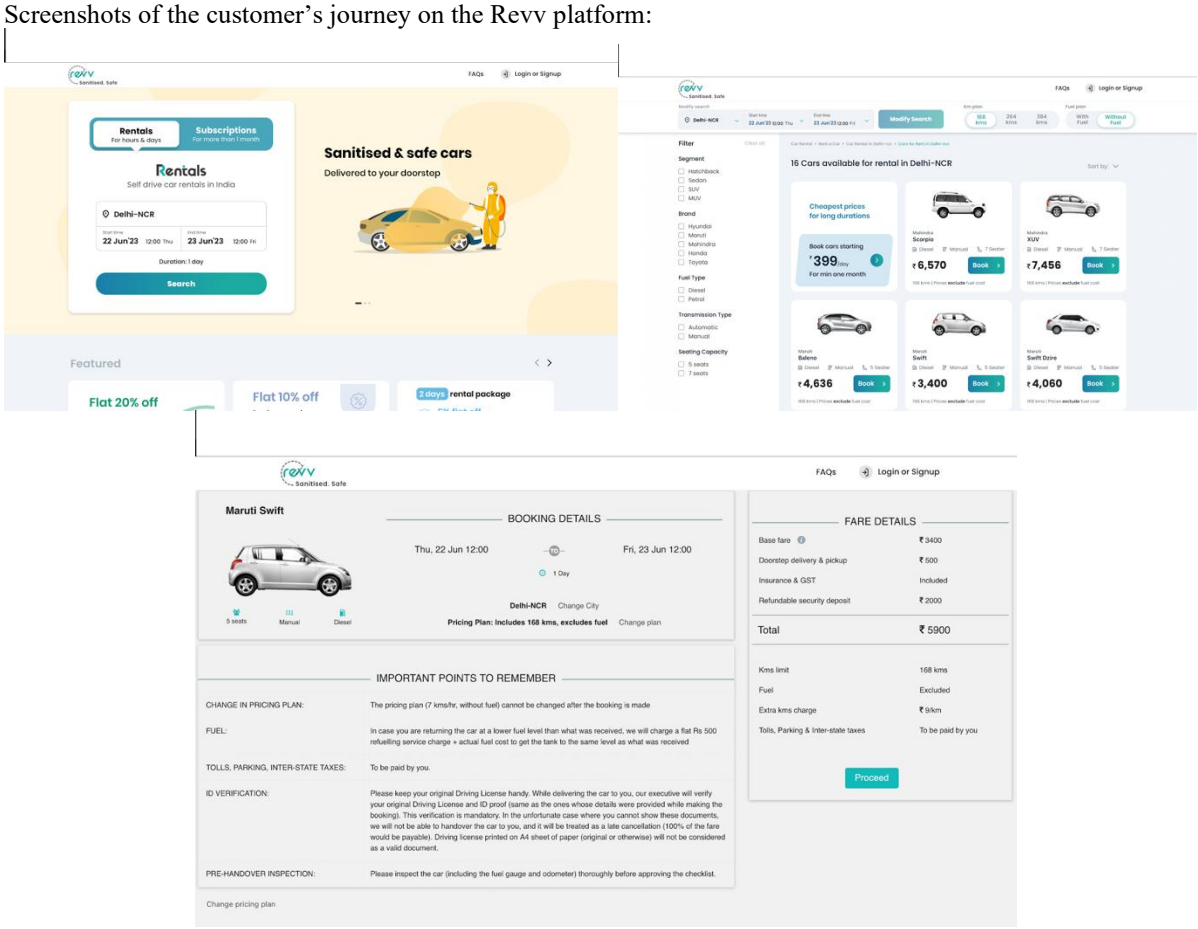
Revv is a technology-first self-drive car rental company based out of India. It started operations in July 2015. Revv has a fleet of over 2000+ cars currently. These include cars from Hyundai, Mahindra, Toyota and many more such companies. Revv operates in 22 different cities across India. Cars are available from any of these cities.

To book a car from Revv, the customers can go to either the app or the website and choose a car. They also need to choose the duration they need the car for as well as the dates of their requirement. They, then, need to choose a point for the car to be dropped off and picked up from (provided that Revv delivers the car there). The car will get delivered to the customer's desired location by Revv.

There are many payment options available for the customers to choose from. A refundable security deposit is also charged from the customers. , this is in case of any damage caused to the car, any fines to be paid or late return of the car. There will also be a fixed cost of doorstep delivery.

There are two main business models of Revv, car rental and subscription. Both models have a similar procedure for car booking and delivery. Car rental is a short-term rental from a few hours to a few days. A subscription is a long-term rental from over 1 month and up to 4 years.

Screenshots of the customer's journey on the Revv platform:

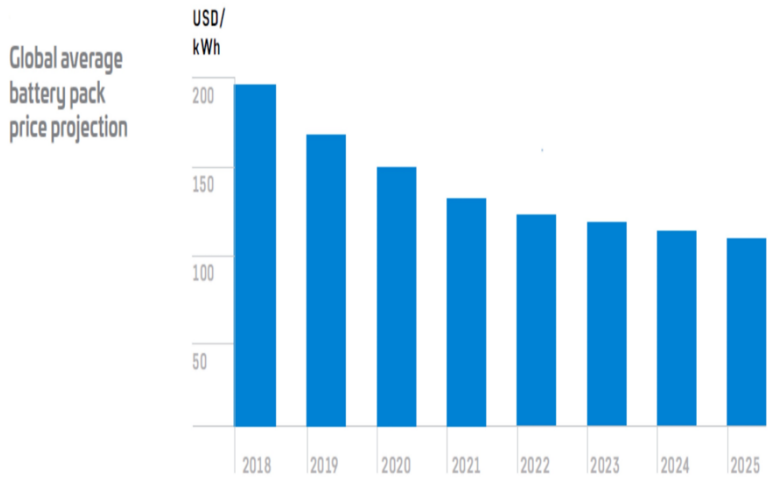


Should Revv switch to electric cars?
If Revv were to evaluate switching to EVs today, there would be many factors to consider such as:-

- As of today, electric cars are much more expensive to buy, as compared to ICE vehicles. As shown above (in Table 1), the price of a Tata Nexon (petrol) is about 5 lakhs cheaper than a Tata Nexon (EV). To switch to electric cars currently would be very costly for Revv currently.
- There are not many electric car models available in the market as compared to the wide variety of ICE vehicles available.
- Electric cars purchased for personal use may be charged at home but customers would not have facilities to charge their electric car if they were to rent one. Since there is a shortage of charging facilities all across the country, customers would have a very limited area of travel.
- Range anxiety is one of the major concerns for customers planning to buy an EV car today. Customers fear getting stuck on longer trips due to shorter battery ranges.

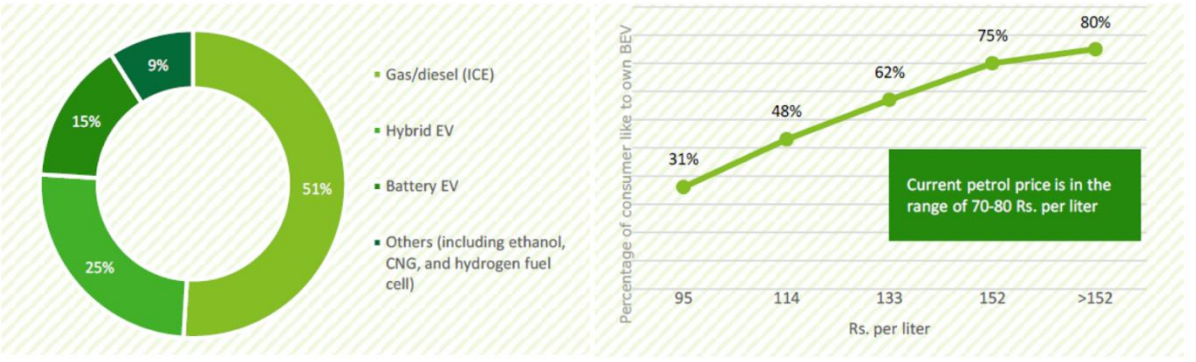
However, in the coming years, the production and variety of electric cars will improve substantially. This is because of many key factors such as:-

- The main cost of an EV is the battery. As technology improves, the cost of manufacturing the battery will go down, as illustrated in the image below.



So, the total price of an electric car is likely to be similar to an ICE vehicle in the coming years.
While upfront cost for an EV is far higher today as compared to an ICE vehicle, the TCO (total cost of ownership) over a period of 5 years favours the EVs subject to certain conditions, as illustrated below.:

- With the help of government regulations, EVs will be the only type of vehicle sold in the market post-2030. There are many new EV models to be launched by companies such as Mahindra (400 Series, BE 09, XUV e8), MG (5 EV, eHS, 4 EV), Tata (Punch, Curvv, Avinya), etc. Many luxury car brands like Mercedes (EQS, EQA, EQE, Maybach EQS 680), BMW (iX1, X5), Testa (Cybertruck), etc. are going to launch EVs. Between June 2023 and January 2025, there are an estimated 41 new electric car models to be launched. This will ensure that the customers will have a lot of choices across car models and price points.
- The EV infrastructure all over India will improve in the coming years. There will be more charging stations available all across the country.
  The government is also planning to launch a master app to help EV users. This app will show all nearby charging stations with their availability. This will help in the adoption of EVs. This app will bring together all the major charging station players such as Tata Power, Bolt, Ather, Charge Zone, Charge Block, and Exponent, etc.
- The battery ranges of EVs have also been improving.



Deloitte, through its Automobile Consumer Study 2020, surveyed 3022 consumers in India to understand opinions regarding critical issues in the automobile sector.

Around 40% of consumers preferred Electric vehicles (Battery/ hybrid) for their next vehicles. However, the decision of buying an EV is dependent upon the price of fuel for ICE vehicles. With the current fuel prices much higher, it is expected that more consumers will prefer electric vehicles over ICE.

ICE vehicles are the primary type of cars in the market today. Electric cars hold a small market share of 1.3% (as recorded in FY 22-23). For Revv to switch to electric cars, with such a small market share, completely could be a huge risk. Therefore, Revv should consider switching over to EVs in a graded manner.

The images below highlights the upcoming models in the mobility industry, along with the expected advantages of shifting to EVs.

In the Indian market, we see similar new emerging companies such as BluSmart. BluSmart is a company providing chauffeur-driven all-electric cars on request. BluSmart operates out of large cities like Delhi and Bengaluru. They hope to expand their coverage and fleet into new cities.

Blu Smart can operate with electric cars as the company has control over the range of travel. The driver can also locate nearby charging stations to ensure the car is charged. Revv, however, cannot control where the customers will take the cars.

Therefore, it is early for Revv to adopt EVs currently. To make a switch to EVs, Revv should observe the market response to companies like BluSmart. Parallely, it should closely follow the developments in the EV ecosystem w.r.t. price reduction, new model launches, development of charging infrastructure, better battery ranges, etc. This will help the company in proactively planning for induction of EVs in its fleet in a gradual manner and yet, reap the benefits of the first-mover advantage.

So the answer is yes, Revv should switch to electric cars, but this switch should come in a few years.

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