



JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Comparison between Fossil Fuel Vs Electric Cars Vs Retrofitted/Converted EV-TCO

(Indian Perspective)

Dec21,2021 Rakesh Patralekh ,Green Energy Expert

abstract

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Retrofitting your ICE-powered cars to electric cars can be a great cost-effective option, as people are looking for fuel alternatives as fuel prices rising in India. Retrofitting technology is the best option to save money and own an EV with less TCO as currently new EVs are very costly and out of reach for common people.

Since electric cars have a lot of benefits for the environment as well as for individual. The more electric cars there are on Indian roads, the more India will be able to reduce carbon emissions and as a result, we will all have a cleaner environment and cleaner air and economically good too for customers and Govt..

One Small Case Study as 38 Lakhs ICEs are about to complete there 10 -15 Yrs. Life time (End of Life) in Delhi Itself.

There could be two scenarios ---

- These 38 Lakhs 4 wheelers would be swapped with new Fossil based vehicles as per thumb rule which would again pollute Delhi during their life time with 5.8Cr Ton of CO₂ in the atmosphere.
- Retrofit these vehicles in to EV, which wud not only save infusion of 5.8Cr Ton CO₂ in the environment during their life span of 1 Lakh KMs but also save Money for the customer due to elevated fuel prise and low running cost almost 1/6th in the case of EVs and in addition to these earning through Carbon Credits too for customers and also this wud be cheaper alternative than new purchase, again savings of the nation's foreign reserves in terms of reduced Fuel imports too.

Now visualise this in terms of entire Nation as above-mentioned case is only for the National Capital Delhi.

Introduction

Electric vehicles (EV) have been around for a while and have been a tempting, but difficult choice for prospective customers ever since the first one hit the market. Tantalising, because fuel prices have been on a steady upward trajectory since 2016; but difficult, since despite both Union and state government subsidies, the initial cost of electric vehicles have remained stubbornly, and significantly, higher than those of its fossil-fuel driven peers.

Last few years have not been a normal one as far as petrol and diesel prices uptrend. Because fuel prices breaching the psychological Rs 100 per litre barrier petrol and diesel prices have risen by 26 per cent and 20 per cent.

So with this sharp increase in fossil fuel prices electric vehicles has become a more attractive option for prospective automobile customers.

But as with any cost comparison for automobiles, the key factor that determines cost efficiency is the amount of use you plan to get out of the vehicle.

Total Cost of ownership-----

As anyone who has ever owned a vehicle realises quite quickly, the total cost of ownership of a vehicle isn't simply limited to the number of kilometres it gives per litre of fuel or unit of electricity rather stringent insurance conditions which require vehicle owners to mandatorily purchase insurance; there are both scheduled preventive and non-scheduled corrective maintenance costs and, not to mention, the cost of replacement parts in case of damage that is not covered by either warranty or insurance.

And these parameters do not stay the same over the duration of ownership either. In the case of fossil fuel vehicles, or internal combustion engine (ICE)-powered vehicles, service costs increase significantly over the years as the automobile gets older. The fuel efficiency or mileage—the number kilometres one can drive per litre of fuel—also tends to decrease. This means fossil fuel vehicles generally become less cost efficient as they get older. But the question, of course, is how the current crop of electric vehicles do on these parameters.

EVs win the race-----

One of the first things one needs to understand with electric vehicles is that in comparison with ICEs, their cost efficiency becomes comparatively better as time goes on.

Their primary problem with four wheelers, is that the initial cost is often times nearly double that of comparable ICE vehicles. Take India's top selling electric car at this moment, the Tata Nexon EV. Its ex-showroom price is just under Rs 14 lakh per unit, compared to around Rs 5.8 lakh for the base version of the petrol Maruti Suzuki Swift and Rs 10 lakh for the Hyundai Creta. The MG ZS EV, another popular electric car, is priced at over Rs 23 lakh.

On the basis of the initial price alone, EVs do not yet beat ICEs. In fact, their insurance costs are also quite a bit higher than ICE vehicles, because expensive EV batteries form nearly 40 per cent of their total cost and insurance plans haven't reached the same kind of scale as for ICEs. Where EVs do well is in the long run. Because while ICEs are less expensive in the showroom, EVs beat them hands down on daily running costs.

Take a look at the per kilometre costs of the above mentioned ICE and EV vehicles. In the 4-wheeler category, ICEs are 6-7 times more costly on the road.

EVs also have significantly lower servicing costs, and unlike ICEs, where service costs rise sharply with age, EVs see much lower service cost escalation over the same period. And because an EV typically has far fewer moving parts compared to ICEs, they are also cheaper in terms of replacements due to wear-and-tear. Based on data gathered from owners and industry sources on the above parameters, it becomes clear that electric vehicles win in terms of cost efficiency the longer they are on the roads.

Calculating for a 5-year period and 1-lakh-kilometers of usage, most electric vehicles come out in front. For instance, low-speed 2-wheelers are many times cheaper than ICE peers and even in the high-speed category, the initial difference in costs is either cancelled out, or sharply reduced.

The difference in costs narrow sharply for 4-wheelers too as the calculations show. The cost of running the vehicle is so much lower than ICEs that over a lakh kilometres of usage in the Nexon EV would cost around Rs 75,000 (at Rs 08 per unit of electricity), while the Maruti Swift is likely to cost Rs 4.8 lakh (assuming that fuel costs remain at Rs 100 a litre).

So, what's the final word/Conclusion-----

Well, if we get down to brass tacks, EVs are still far costlier at the showroom and cost even more for insurance. But, over the course of use, their cheaper fuel and service make them steadily more viable. And the more kilometres you drive, the more cost efficient EVs get.

Again what is the solution to make EV more cost effective and in reach of middle-class customer as far as Total Cost of Ownership TCO is concerned?

Solution is retrofitting the existing Fuel based Cars(EOL on priority) to EV and get benefited by the advantages in terms of low running cost/TCO and reduction in the carbon footprint too, resulting again in additional savings by means of Carbon Credits/Certificates.

As per one survey, **in Delhi alone 3 Lakhs Diesel Cars and 35 Lakhs** Petrol based cars are about to complete 10 and 15 years of Life on road this fiscal thus will be de registered automatically as per the new guide lines of SC.

Now there cud be 2 Scenarios-----

- These 38 Lakhs 4 wheelers would be swapped with new Fossil based ICE vehicles as per thumb rule which would again pollute Delhi during their life time with 5.8Cr Ton of CO₂ in the atmosphere.
- **Cost-effectively Retrofit** these End of Life ICE vehicles into EV which wud not only save infusion of 5.8 Cr Ton of CO₂ in the environment but also save Money for the customer in terms of very low running cost and again in addition to this, earning through Carbon Credits at prevalent international rates of Carbon Certificates and at last but not least, savings of the nation in terms of foreign reserves needed for Fuel imports.

Now visualise this in terms of entire Nation.



EV Retrofit Technology: Conversion Kit, Cost

Retrofitting Technology to convert your Petrol/Diesel Car into Electric Car

Looking up the dictionary, one would stumble upon the definition of retrofitting as “to furnish (something such as old Electrical/Mechanical, Remote systems, or any system) with new or modified parts or equipment not available or considered necessary at the time of manufacture.” That is what retrofitting is in the literal sense. Now let’s see it in the terms of electric vehicles.



To upgrade/furnish (combustion engine and FUEL tank) with new or modified parts or equipment (motors and batteries/fuel cell) not available or considered necessary at the time of manufacture.

Rear Differential System for Wheels for ICE Retrofitting to EV



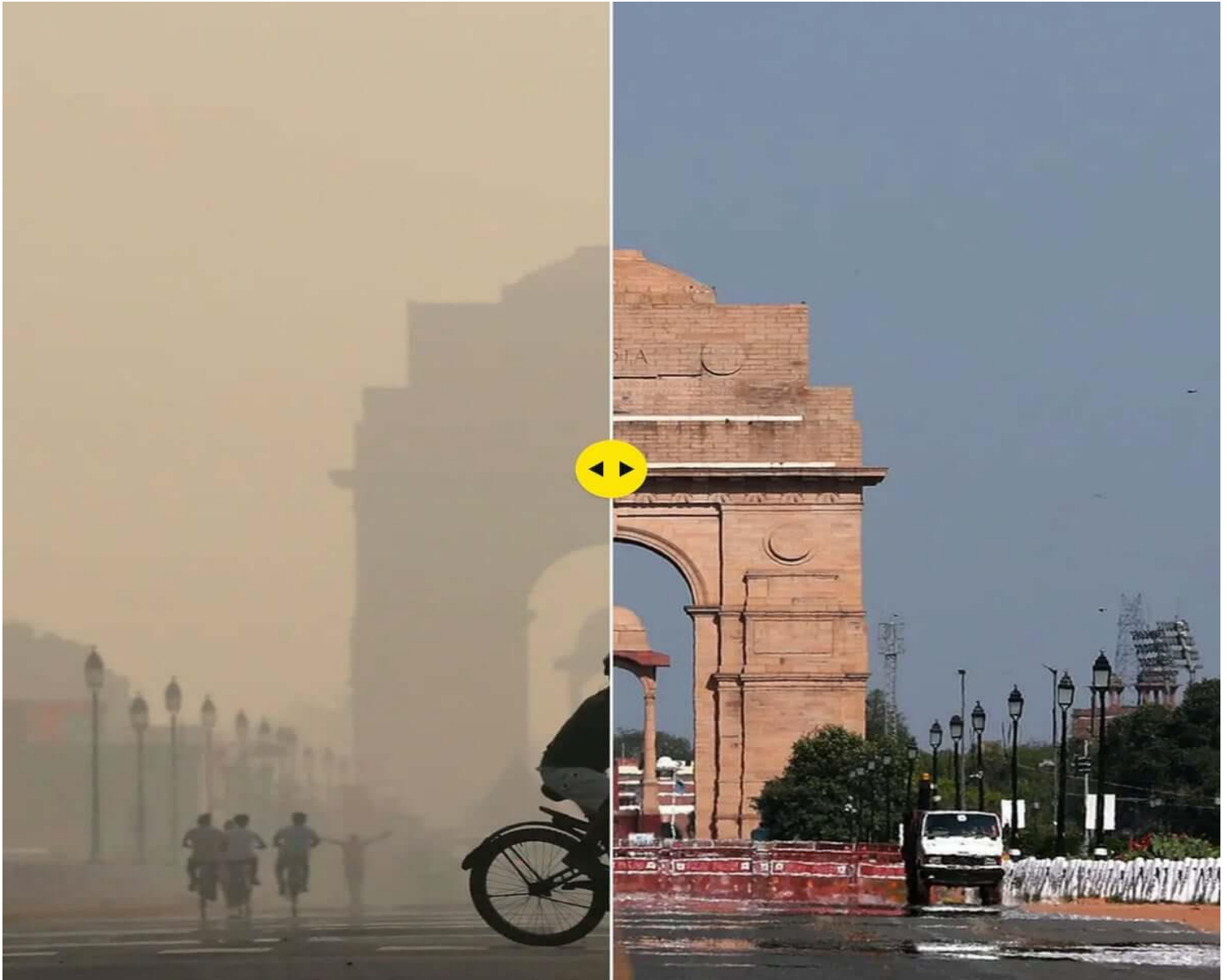
History of EV Retrofit Technology

Historic 1998 decision by the Supreme Court of India to phase out diesel buses from the roads of Delhi. The then-record levels of pollutants in the air compelled the Supreme Court to grant relief to the citizens.

Well, **what was the point of the verdict?** The bench proposed that the highly polluting **buses** be either taken off the roads or the diesel engine be replaced with a cleaner alternative. Retrofit it with Compressed Natural Gas (CNG). The decision was well thought out and necessary for the safety of citizens and to ensure a citizen's right to clean air.

Similarly couple of years back Supreme Court Of India again gave a historic decision considering hi level of pollution in Delhi that 4 wheelers with age of 10 and 15 years respectively in case of Diesel and Petrol would be de-registered automatically and the registration cud be renewed only if converted into Electric Vehicles by swapping their ICE through Electric Motors and Batteries.

Delhi with and without (or very low) levels of Air Pollution



Now, let's jump back to the present day. Even though the amount of emissions per vehicle is decreasing due to improvements in technology, pollution levels are rising once again as the number of vehicles is increasing to meet the growing population. In such a situation, a similar policy can be expected from the government.

As I mentioned, the first solution was to retrofit diesel buses with **CNG**, and now the time has come for the entire engine to be replaced with motors that are powered by either batteries or fuel cells. But yes, retrofitting is a cost-effective solution.

What is Needed for Retrofitting your Petrol/Diesel Car?

Now that we know what retrofitting is, we can now learn what is needed to retrofit your car.

The safest method is to take your car to one of the retrofitters like us who have experience and having adequate technology and are well versed in this regard. Here not only the Vehicle would be converted into EV but also all the necessary Govt approvals would be obtained for yr 10-15 yrs old off the road as per Govt guide line for diesel/petrol vehicle so that yr vehicle could run for further 1.5Lakhs Kms that to very cheap and carbon free.

What's included in an EV Conversion kit?

- Motor
- Controller
- Shunt
- Transmission adapter kit
- Charger
- Chill plate
- DC/DC converter
- Throttle controller
- Controller mount



How to Convert Petrol Car into Electric Car- Retrofitting Electric Car

The first step is to zero in on the car you want to Retrofit. A light car like a Maruti 800 is much easier to retrofit than to retrofit a minivan or sports utility car. Make sure its internal components are working. Elements such as the transmission shaft must not be broken or cracked. Or in other words, make sure the car is in good overall condition and is structurally sound.

The next step would be to convert a conventional vehicle to an electric car, removing all ICE-related hardware. Including engine, fuel tank, muffler, exhaust, starter, and radiator. They will be replaced by myriad components, the most important of which is the electric motor. The size of the motor used will depend primarily on the size of the vehicle, expected performance, and weight.

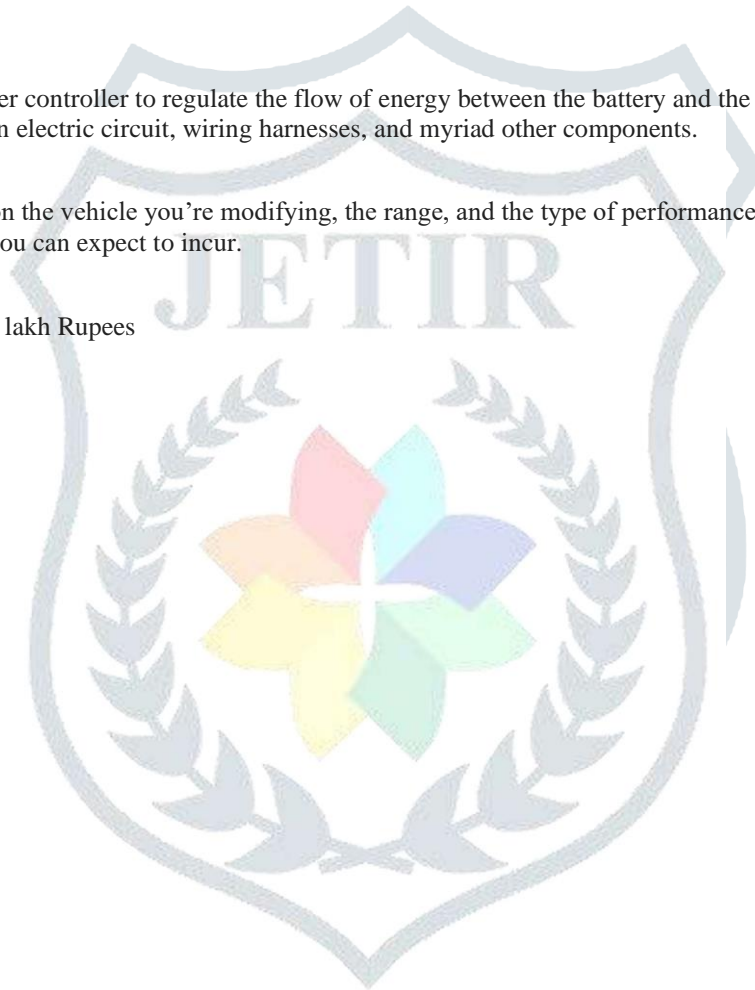
Next comes the battery pack, the powerhouse of electric vehicles. One would need to decide between a lead-acid battery and a lithium-ion battery (or go with a hydrogen fuel cell which is quite rare). Lead-acid batteries used in golf carts are often installed, although they generally provide a slim operating range on a single charge.

Next come lithium cells, which are smaller and lighter and can enable longer ranges but are more expensive and require more protection electronics on board. How many batteries will be required will depend on the vehicle and the available space in which they are to be fitted.

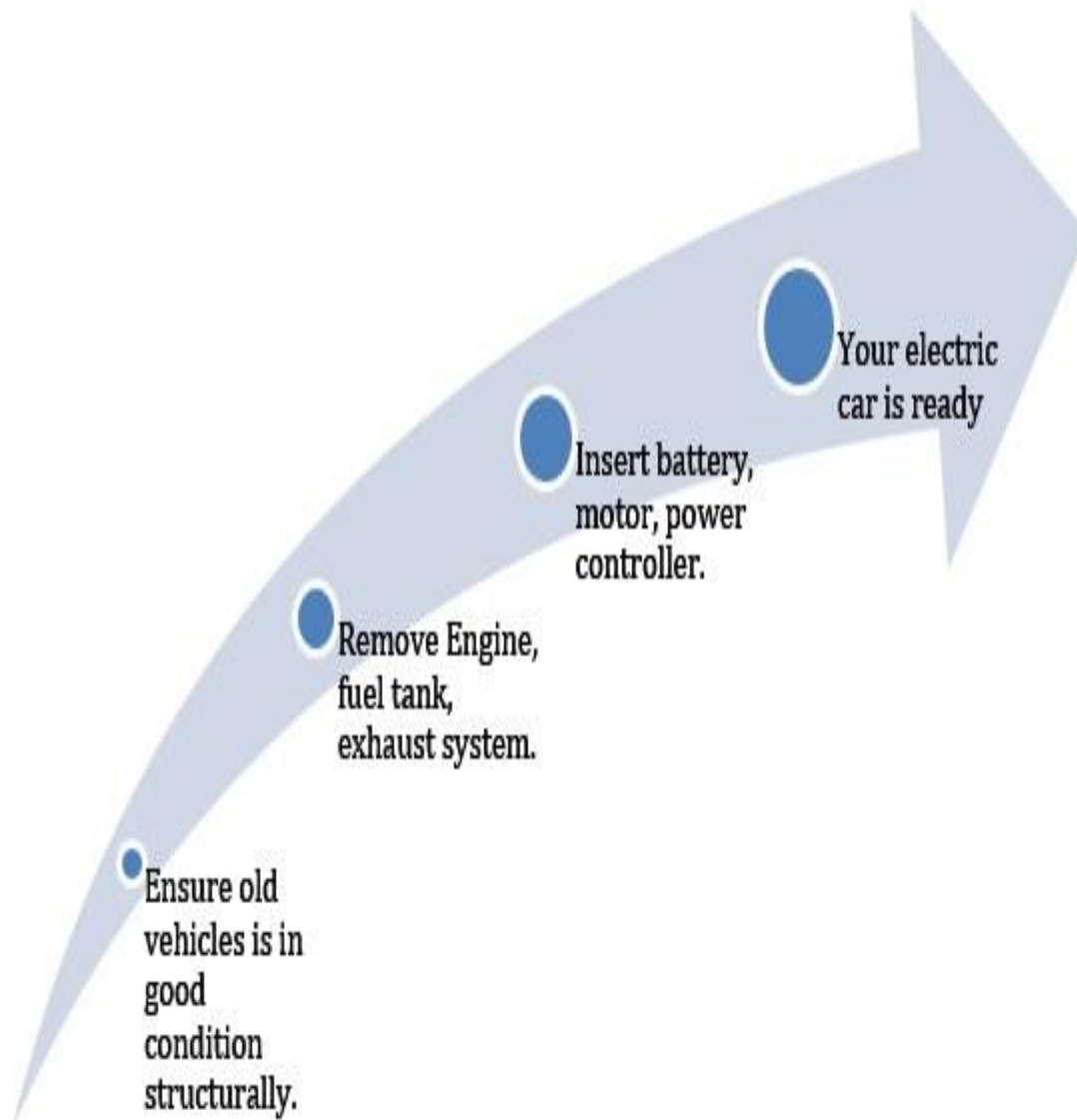
There also is a need of power controller to regulate the flow of energy between the battery and the motor, a charging system to replenish the batteries via an electric circuit, wiring harnesses, and myriad other components.

The total cost will depend on the vehicle you're modifying, the range, and the type of performance you're expecting. But here's a rough estimate of the cost you can expect to incur.

- Maruti Dezire –4.0 lakh Rupees



A Flow chart of the Conversion Process



A flowchart of the conversion process

Retrofitted EV Car, Make Old ICE Fiat





Li-Ion Bank Fitted at the boot space of Old Fiat Car

Advantages of Retrofitting Technology

Not one, not two, But many. There are myriad benefits to retrofitting your ICE-powered car.

From the customer's point of view,

- you can reduce your operations cost almost by 1/7th as the cost of electricity per km is significantly less when compared to petrol or diesel
- The maintenance cost of an Electric vehicle is considerably less than that of an ICE vehicle
- comfort – both mentally and physically. EVs do not suffer from excessive noise and vibration when compared to some old ICE light cargo vehicles.
- Adding to all those above, you would be proud that you are doing your bit to help the community go green and save Nations critical Foreign Reserves used for fuel imports along with carbon Zero.

Comparison between ICE VS EV Vs Converted EV(Car)**ICE vs EV vs Retrofitted EV (4 wheeler) TCO along with/Km running cost in INR till EOL of Vehicle**

Model	Ex showroom	Av 5 Yrs Insurance Cost	Av 5 Yrs Service Cost INR	Price/Kms INR(Fuel or EB)	50000 KMs Fuel Cost	100000 KMs Fuel Cost	TCO(5Yrs -1 lakh KMs)	Per/Km running Cost of vehicle till EOL(TCO/1 Lakh)
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INTERNAL Combustion Engine

Maruti Swift	581000	95000	23500	5.9	295000	590000	1289505.9	12.90
Hundai Creta	999000	110000	16000	6.7	335000	670000	1795006.7	17.95

Electric Vehicle New

Nexon EV	1399000	110000	20000	0.76	48000	96000	1625000.8	16.25
Hyundai Kona	2371858	175000	6000	0.64	40000	80000	2632858.6	26.33

Retrofitted Electric Vehicle TCO

Model	Ex Workshop(@ Rs 1 lakh 10KVA Kit +150Ah L-I BB)	Av 5 Yrs Insurance Cost	Av 5 Yrs Service Cost INR	Price/Kms INR(Fuel or EB)	50000 KMs Cg Cost	100000 KMs Cg Cost	TCO(5Yrs /1lakh KMs)	Per/Km running Cost of vehicle till EOL(TCO/1 Lakh)
Maruti Swift	380000	50000	25000	0.76	38000	76800	531800.77	5.32
Hundai Creta	400000	60000	25000	0.64	40000	80000	565000.64	5.65

Cost of fuel considered is Rs 100/Ltrs and Per Unit Cost of EB is taken to be is Rs 8/Unit

Carbon Credit Earnings towards Carbon Savings would be INR 57600/- for 1 Lakh Kms of running ie for approx. 6666Kgs of CO2 Saved

Disadvantages of Retrofitting Technology

- Batteries may need to be placed in different places. (i.e. the batteries may have to be kept in the rear of the vehicle or may have to be kept on the side for a two-wheeler). This increases the instability of the vehicle when compared to a vehicle designed for petrol or diesel.....
- The initial cost of retrofitting can exceed the cost of a new small petrol vehicle.

References- <https://www.tesla.com/>, Tata Motors and internet for relevant Snaps & i/ps.