Using Finance to Make Electric Vehicles Cost-Effective

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Electric vehicles (EVs) have multiple advantages, including reductions in global air pollution, local air pollution, oil imports, etc.¹ In particular, EVs are likely to play a key role in the decarbonization of transportation.² The transportation sector currently accounts for 15% of global emissions worldwide,³ and 40% in California.⁴

Given this, many countries are pursuing aggressive EV targets—including Australia, Germany, India, and China—with the developing countries taking a lead. For example, China has set a target that EVs account for 25% of new car sales by 2025.⁵ India has a similarly ambitious target: that 30% of all vehicles are EVs by 2030.⁶

In this context, it is pertinent to examine the key barriers to large-scale EV adoption. These include: aspirational value, range anxiety, and—eventually—finance.⁷ The aspirational value relates to whether, based on preferences, a decision maker views a vehicle as desirable to own. This is been largely addressed by companies such as Tesla.⁸ The range anxiety relates to whether the user would need to worry about running out of charge at inconvenient times. This is starting to be addressed by fast chargers and charging networks.⁹

In this thought piece, we explore the last barrier (i.e., finance¹⁰) and how it could be overcome using innovative

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² See https://www.sciencedirect.com/science/article/pii/S0306261919307834
³ See https://www.c2es.org/content/international-emissions/
⁴ See https://www.biologicaldiversity.org/programs/climate_law_institute/transportation_and_global_warming/index.html
⁶ See https://www.forbes.com/sites/scottcarpenter/2019/12/05/can-india-turn-nearly-200-million-vehicles-electric-in-six-years/#2e736b3e15db
⁷ See https://www.forbes.com/sites/jeffmcmahon/2019/01/27/the-4-lingering-obstacles-to-electric-vehicle-adoption-and-what-might-overcome-them/#22666aa45c54
⁹ See https://www.consumerreports.org/hybrids-evs/electric-car-charging-network-is-expanding/
¹⁰ See https://qz.com/1701143/price-not-range-is-the-reason-people-will-buy-electric-cars/
approaches. Simply put, the capital expenditure (CAPEX i.e., initial cost) of EVs is higher than comparable regular vehicles using an internal combustion engine (ICE).\textsuperscript{11} This is primarily due to the battery costs, even though the rest of the vehicle may actually be cheaper given reduced mechanical complexity.\textsuperscript{12}

The key insight here is that, while the capital expenditure of EVs tends to be higher compared to comparable ICE vehicles, the operating expenditure (i.e., yearly cost, or OPEX) tends to be much lower. This is due to cheaper fuel—electricity vs fossil fuel—and maintenance costs.\textsuperscript{13}

That is, over the lifetime of a vehicle, accounting for both capital and operating expenditures using a metric called the total cost of ownership (TCO), many EVs are now less expensive than comparable ICE vehicles.\textsuperscript{14} This is true even after appropriately discounting operating expenditures, and using the well-known concept of net present value (NPV).\textsuperscript{15}

This brings up the obvious question: If EVs have cheaper total cost of ownership than comparable ICE vehicles, why does cost—in particular, higher capital expenditure—remain a barrier?

Note that this barrier manifests itself only in some situations and, in fact, has been addressed in other contexts. The key element is whether the buying decision is based on total cost of ownership or on capital expenditure. This creates a dichotomy between business vs. individual buying decisions.

In particular, this barrier does not manifest in situations where the buying decision is based on total cost of ownership and not just on capital expenditure. This is more likely to happen when businesses make the buying decisions; examples of this include public transportation as well as fleet operators. For example, in public transportation, many municipalities request proposals from private operators to bid on levelized cost of transportation (LCOT) in $/Km. This is another form of total cost of ownership, and the lowest bidders win.\textsuperscript{16} Under this model, the private operators essentially consider the forecasted fuel costs and bear associated risks.

However, this barrier still manifests in situations where buying decisions are based on capital expenditure and not total cost of ownership. This is more prevalent in private purchases,\textsuperscript{17} despite the fact that individuals still need to not only pay fuel costs but also bear associated risks of fuel price volatility.

This dichotomy—between business and private buying decisions—suggests that there may be ways to make EVs appear more attractive to individuals. At a high level, these would require annualizing\textsuperscript{18} capital expenditures and even potentially assigning an appropriate fraction of the same into operating expenditures. Similar models—i.e.,

\begin{itemize}
  \item See \url{https://www.inc.com/minda-zetlin/electric-car-ev-battery-range-cost-less-than-gas.html}: An electric Ford Focus is 62% more expensive than a comparable ICE car.
  \item See \url{https://www.energy.gov/eere/electricvehicles/saving-fuel-and-vehicle-costs}
  \item See \url{https://www.forbes.com/sites/anthonyeggert/2019/06/12/yes-electric-cars-will-be-cheaper/#2e3b1caf2226} as well as \url{https://cleantechnica.com/2018/02/05/new-study-finds-electric-vehicles-offer-lowest-total-cost-ownership/}
  \item See \url{https://www.academia.edu/29851431/Total_cost_of_ownership_of_electric_vehicles_compared_to_conventional_vehicles_A_probabilistic_analysis_and_projection_across_market_segments}
  \item See \url{https://gggi.org/site/assets/uploads/2019/04/Public-Transport-Concessions-Full-report-English.pdf} as well as \url{http://www.urbanmobilityindia.in/Upload/Conference/4e5f5412-a7a6-4438-aab4-f716912149ad.pdf}
  \item See \url{https://morningconsult.com/2019/05/22/for-widespread-adoption-of-electric-vehicles-many-roadblocks-ahead/}
  \item Annualizing, in the simplest form, would mean dividing the capital expenditure by the lifetime of the asset. For example, a $30,000 vehicle with a lifetime of 10 years would have annualized capital expenditure of $3,000. Now, if future is discounted using an appropriate discount rate, this annual capital expenditure would change so that the net present value of these annual installments would be equal to the original capital expenditure.
\end{itemize}
leases and power purchase agreements—helped the solar photovoltaic (PVs) gain traction with individuals.\textsuperscript{19}

For example, imagine that, when buying a vehicle, an individual would pay for both the vehicle and the fuel in equal annual installments over time. These equal installments would need to include an annualized version of the capital expenditure as well as average operating expenditure. Now, if the total cost of ownership for EVs is attractive compared to ICE vehicles, these installments are also likely to be cheaper. That is, there is clearly a case for EVs to be cost-effective compared to comparable ICE vehicles.

The trick is in how to make this work; the devil is in the details! To be able to compare these installments across EVs and comparable ICE vehicles at the buying date, we need the two constituent annual components: the annualized version of capital expenditure as well as average operating expenditure. Note that the former is already present in the form of mortgages and leases,\textsuperscript{20} so that should not be hard to either understand or justify.

However, an issue may arise in establishing the average (or expected) operating expenditures on the date of purchase. Typically—even though the consumer is responsible for the operating expenditures, and bears the risk around fuel cost volatility\textsuperscript{21}—while some consumers do think in terms of total cost of ownership, many consumers are not likely to be trained in thinking about expected operating expenditures and will focus only on capital expenditure.

In these cases, two approaches may help to make a case for EVs being cheaper compared to ICE vehicles, both of which are driven by automobile manufacturers.\textsuperscript{22}

The first approach would be for automobile manufacturers that make both EVs and ICE vehicles (e.g., Ford, or for that matter, all traditional manufacturers) to start offering both vehicle types at annual installments that cover both capital and operating expenditures. As discussed above, the coverage of capital expenditure already happens today in the form of mortgages and leases. Covering operating expenditures may require automobile manufacturers to get into operating contracts (including fuel) with consumers and then hedge their fuel-related risks in commodity as well as financial markets.

While feasible, this approach could pose its own set of issues. The first one being that automobile manufacturers may not want to get involved in fuel contracts, given that this requires experience with commodity trading and financial markets. The second one being that, by doing so, automobile manufacturers may expedite the cannibalization of their own ICE vehicle business. While both of these issues are surmountable, doing so may require strategic leadership from some manufacturers.

The second approach would be for automobile manufacturers that make only EVs to start offering EVs at annual installments while clearly specifying the annualized capital expenditure and expected operating expenditure components. In this context, they can also provide comparisons with corresponding annual installments for comparable ICE vehicles in the market. Separating the battery capital expenditures from the cost of rest of the vehicle will help further by allowing for annualized battery capital expenditures to be viewed more clearly as expected operating expenditures.\textsuperscript{23}

While these innovative approaches may require many details to be sorted out, thinking along these lines will

\textsuperscript{20} See https://www.goodfinancialcents.com/is-it-better-to-lease-or-buy-a-car/
\textsuperscript{22} Of course, in this context, there may be suitable roles for other stakeholders, such as policymakers, electric utilities, etc.
\textsuperscript{23} See https://mobilebatterysquad.com/finance-your-new-car-battery for battery financing options
help individuals overcome the capital expenditure barrier. This may allow widespread adoption of EVs in a much faster way, and help the world move towards its environmental goals, both local and global!

ABOUT THE AUTHOR

Gireesh Shrimali is a Precourt Scholar at the Sustainable Finance Initiative (SFI) at Stanford University. His research focuses on the intersection of policy and finance: in climate in general and energy in particular. At SFI, he is examining energy system transitions, with a focus on the design of effective policies and financial instruments. The promising topic of electrification of transportation has brought his attention to scaling electric vehicle adoption using finance.