Getting to India's Electric Vehicle Targets Cost-Effectively

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Overview

India has ambitious climate targets, as demonstrated by its Intended Nationally Determined Contribution (INDC) declared in the Paris COP in 2015. Among the declared ambitions, a primary focus is on getting to 40% generation capacity by renewable energy (RE) by 2030 (NRDC, 2019). Another, albeit internal, focus was initially on getting to 30% of vehicle fleet by electric vehicles (EVs) by 2030 (Forbes, 2019).

There are many barriers to widespread EV adoption, however, including in India (Rubens et al, 2020). The first barrier is typically higher upfront costs, also known as capital expenditure (CAPEX), compared to comparable internal combustion engine vehicles (ICEV). The difference in CAPEX is largely driven by the upfront cost of batteries which remain a significant component of EV CAPEX.

This barrier brings up the question of subsidy support, prompting India to announce two concrete policies to support EVs – FAME I and FAME II. In the context of policy (i.e., subsidy) support for EVs, we are then interested in two related questions, as follows.

- Question 1: Which vehicle segments should be subsidized, if at all?
- Question 2: Which policy should be used to subsidize chosen vehicle segments?

Methods

While many well-known financial metrics exist in theory (Brealey et al, 2016), such as CAPEX, Payback, and internal rate of return (IRR), we use net present value (NPV) and its equivalent, total cost of ownership (TCO), to compare cost-competitiveness of not only of EVs with respect to comparable ICEVs but also of subsidies. We assert that NPV is the only rational financial metric among the remaining financial metrics, given that Payback is subjective and typically much shorter than the product lifetime, and IRR does not always work especially given the problem of multiple IRRs in presence of recurring CAPEX due to battery replacement.

In our case, we restrict ourselves to the three types of subsidies, as explained below, which cover a wide range of individual financial incentives (Shrimali et al, 2017). First, capital expenditure (CAPEX) subsidy: These are one-time subsidies, typically provided at the time of purchase. Second, operating expenditure (OPEX) subsidy: These are yearly subsidies, typically defined in per km (or mile) terms and calculated based on (expected) distance travelled per year. Third, financing expenditure (FINEX) subsidy: These are also yearly subsidies, typically calculated to reduce the relevant discount rate seen by the consumer (or the borrower).

Results

We first present results on the need for subsidies, using the TCO metric (Table 1). We then present results on the cost-effectiveness of various subsidies, using the NPV metric (Table 2).

Table 1: TCO comparison and need for subsidy

Vehicle type	TCO-ICE (INR/km)	TCO-EV (INR/km)	TCO-EV/TCO-ICE (%)	Need subsidy?
2W-personal	5.06	3.49	69%	No
2W-freight	2.08	1.04	50%	No
3W	4.05	3.28	81%	No
4W-taxi	9.12	8.59	94%	No
4W-car	18.05	23.17	138%	Yes
4W-bus-intracity	54.91	46.11	84%	No

(9M)				
4W-bus-intercity (9M)	43.57	34.68	80%	No
4W-truck	30.45	46.72	153%	Yes

Table 2: NPV of subsidy comparison for cars and trucks

Vehicle type	CAPEX-subsidy (INR)	OPEX-subsidy (INR) [% increase from CAPEX-subsidy]	FINEX-subsidy (INR) [% increase from CAPEX-subsidy]
4W-car	589,025	699,513 [+19%]	724,927 [+23%]
4W-truck	16,158,245	21,239,069 [+31%]	NA

Conclusions

We first examine the question: Which EVs would need subsidies? To answer this question, we examine the lifetime cost competitiveness – based on the TCO metric – of various EVs with respect to comparable ICEVs (Table 1). We find that many EVs – 2Ws, 3Ws, 4W-taxis, and 4W-buses – do not need subsidies at all, given lower TCOs for EVs. We also find that some EVs – 4W-cars and 4W-trucks – may need subsidies, given higher TCOs for EVs, if policymakers want to deploy these EVs now. However, even these subsidies can be reduced if policymakers decide to wait on subsidizing these EVs, to benefit from cost reductions obtained via across-the-segment learning effects as other EVs with TCO parity get deployed.

We then examine the question: Which policies be cost-effective for subsidizing 4W-cars and 4W-trucks? To answer this question, we examine the lifetime subsidy cost under three subsidy options – CAPEX, OPEX, FINEX (Table 2). We find that the CAPEX option is the most cost-effective, whereas the FINEX option is the least cost-effective, with the OPEX option has costs like the FINEX option. Our results suggest that a cost-effective policy in India would be to subsidize only 4W-cars and 4W-trucks, using the CAPEX subsidies.

The policy implications for India's EV policies, including the FAME schemes, are as follows. If cost-effectiveness were the focus on FAME, while it uses the cheapest option to subsidize (i.e., CAPEX-subsidy), it is unlikely to achieve maximum cost-effectiveness due to subsidizing EV categories that do not need subsidies – i.e., 2Ws, 3Ws, 4W-taxis, and 4W-buses. This may be due to other reasons, including focus on upfront costs, which may require other effective solutions such as business models and financing mechanisms. Finally, India is unlikely to achieve maximum cost reductions on 4W-trucks given that they are unlikely to experience the full range of learning effects inherent in early deployment.

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