IOSR Journal of Economics and Finance (IOSR-JEF)
e-ISSN: 2321-5933, p-ISSN: 2321-5925.Volume 14, Issue 2 Ser. III (Mar. – Apr. 2023), PP 47-58
www.iosrjournals.org

Economic feasibility analysis of Electric Trucks in India

Shivani Sharma
Scholar at Indian School of Public Policy
Email:sheewani3@gmail.com

Executive Summary
In the quest for resolving climate change issues, many new and innovative solutions have been proposed. Decarbonization i.e., to reduce carbon emissions is one such proposed intervention. Many governments and policy-makers around the globe are taking this issue seriously and have pledged to mitigate their carbon footprints. The Government of India has also pledged to achieve net zero by 2070. For this, the Government has adopted a long-term strategy to reduce its projected carbon emission by one billion tonnes by 2030[1].
For achieving this goal, energy-intensive sectors such as transport are pivotal. With the increasing disposable income, the demand for consumer goods has increased which has led to the growth of the logistics sector further triggering freight transportation. As per the joint report published by Niti Aayog and RMI India, it is reported that India handles 4.6 billion tonnes of goods each year and the freight activity is going to increase by 5 times by 2050 in India. [2]
70% of the freight activity is carried by road transport and 90% of the freight vehicles are fuelled by fossil-based fuels which is one of the significant causes of air pollution and GHG emissions. This growth will have a significant bearing on our GHG reduction goals. Therefore, to achieve these goals, comparatively cleaner electric trucks have been proposed globally.
This paper aims to analyze the feasibility of adopting cleaner electric vehicles in the freight mobility sector by looking at the implications of such a move on the Government, truck owners, and the general population of the country.

Date of Submission: 05-04-2023 Date of Acceptance: 17-04-2023

Context

The Logistic sector is key to economic growth. Currently, India's logistic sector has a market size of INR 11 lakh crore and is expected to increase by CAGR of 7%. The main growth drivers are the rising population, increasing disposable income, and spurring e-commerce sector.[3] Road transport is the dominant mode of freight transfer in India. It accounts for 71% of the total freight movement in the country followed by rail and water.[4] (see

[1] https://www.downtoearth.org.in/news/climate-change/cop26-modi-offers-panchamrita-concoction-for-climate-conundrum-at-glasgow-80001
[2] niti.gov.in/sites/default/files/2021-06/FreightReportNationalLevel.pdf
[3] https://www.niti.gov.in/sites/default/files/2021-06/FreightReportNationalLevel.pdf
[4] https://morth.nic.in/road-transport#:~:text=The%20Road%20Transport%20Sector%20accounts,traffic%20movement%20in%20the%20country.

Figure 1 Modal Share of freight movement in India, 2021

Source: Niti Aayog, 2021

Currently, within road transport, more than 90% of freight vehicles are dependent on fossil-based fuel and the rest rely on CNG. These fossil-based fuels are a significant cause of pollution in the country. Moreover, road freight consumes around ~70 million tonnes of oil equivalent accounting for 53% of the country's transport fuel consumption.[5] Considering the growing demand for freight, and its negative impact on the environment and public health, decarbonization of freight transport is encouraged.

To decarbonize road transport, the Government of India has adopted various measures. These measures include the adoption of schemes such as FAME (Faster Adoption and Manufacturing of Electric and Hybrid Vehicles) which is an incentive-based scheme that provides subsidies to encourage the adoption of electric vehicles by bringing down the cost differential between electric and ICE vehicles and to further accelerate the adoption of e-vehicles, the production linked incentives are introduced for the production of advanced chemistry cell (ACC) battery storage.

However, the uptake of electric vehicles in the freight segment is dependent on various factors such as affordability, technology, and availability of charging infrastructure, therefore, the later part of the study shall understand as to what are the steps taken by the government increase the offtake of e-trucks in India.

At this stage, until India achieves economies of scale, it becomes imperative for the state to incentivize electric truck purchases. The government of India has been offering various incentives to reduce the cost differential to improve the attractiveness of electric mobility, this study shall aim at analyzing these incentives and give a view of how these incentives has affected the total cost of ownership in India.

This study first examines the incentives offered by the Government of India to reduce the total cost of ownership of electric trucks, and then the comparison is drawn with similar model diesel truck (ICE or internal combustion engine) to answer questions such as-Arethese incentives attractive enough for a truck owner to switch from diesel to electric at this stage, and if not what must the government possibly do?

Methodology

At this stage, until India achieves economies of scale, it becomes imperative for the state to incentivize electric truck purchases. With this premise, the Government of India has been offering various incentives to reduce the cost differential to improve the attractiveness of electric mobility,

To calculate the incentives offered by Government, the concept of the total cost of ownership (TCO) has been used. The TCO has been calculated for two types of trucks i.e., ICE truck and electric based in three scenarios which are mentioned below:

I. **Base Case:** In this case, the actual cost of an electric truck vis-à-vis ICE/diesel truck has been calculated i.e., without considering any subsidy on electric trucks, and any taxation on ICE trucks is also avoided.

II. **Tax/Subsidy on Fuel:**In this case, we have introduced taxation on diesel for ICE trucks and a subsidy on electricity for electric trucks over the base case.

III. **As-Is Case:** In this case, we have taken all the subsidies and incentives on electric trucks and all types of taxes on ICE trucks as given by the Government of NCT of Delhi[6].

These three scenarios are used to understand and will give us a viewpoint as to what are its implications on government spending in subsequent sections.

[5]https://cstep.in/drupal/sites/default/files/2022-06/The%20Potential%20to%20Electrify%20Freight%20Transportation%20in%20India_Final_03.06.22.pdf

[6]E-Amrit Portal, https://e-amrit.niti.gov.in/home

1. Technical Operations Assumptions:

1.1 General Specifications: These specifications are common to both. This paper has assumed the following for the sake of simplicity:

Table 1 General Specification of trucks under study

Gross Vehicular Weight (GVW)	7-8 ton
Life of Truck	10 years
Operations	500 km per day[7]
Financing cost	12%
Maintenance Charges	0.5 lakh

Table 2 Specification of Electric truck under study

Gross Vehicular Weight (GVW)	7.4 ton
Range	100 km per day
Charging time	~ 2 hours
Battery Capacity	62.5 kWh [8]
Mileage	1.6 km/kWh [9]
Cost	15.29 lakh [10]

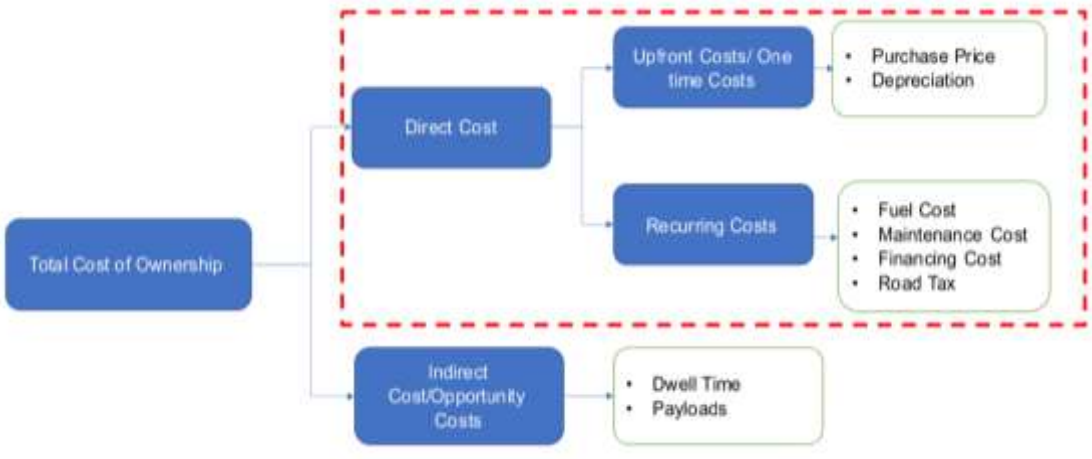
Table 3 Specification of Diesel truck under study

Gross Vehicular Weight (GVW)	7.3 ton
Mileage	~8 kmpl
Fuel Tank	60 liter
Range per day	480 kmpl
Fuel refilling time	<5min
Maximum Speed	80 kmpl
Cost	12 akhs

2. Analysis

The Total Cost of ownership has two components- Direct and Indirect Cost. Direct costs include the expenses incurred directly either for upfront purchase or for maintenance of the truck, while an indirect cost is that component of the cost that calculates the opportunity costs of using an electric truck over a diesel truck. In this study, only direct costs are considered. Within the upfront cost, only the purchase cost of the vehicle is considered and within the recurring costs, fuel costs, maintenance costs, financing costs, and road tax are considered.

Figure 2: Components of Total Cost of Ownership



[7] The administrative delays in freight movements are not considered.

[8] Tata T.7 Electric Product sheet data, https://tatatrucks.tatamotors.com/autoexpo-trucks/pdf/ULTRA_T7_Electric_Truck.pdf

[9] Calculated: Mileage= Range per day/ Battery capacity

[10] https://trucks.tractorjunction.com/en/tata-truck/ultra-t7-electric

2.1 Scenario 1 – Base case

i.) Electric Truck

Since no subsidy has been applied, therefore, a user has to make a full payment of Rs 15.29 lakh. If the user finances a vehicle (in this case, a truck) then the interest on the loan which is also called a financing cost of 12% is applied annually. The term of the loan is assumed to be 10 years and so as the life of the vehicle. However, in India, as per the vehicle scrappage policy, the life of commercial vehicles is kept at 15 years, but this will not impact our study. Using a term of 10 years, financing cost of 12%, and purchase cost of 15.29 lakh without subsidy on loan and upfront cost the annualized cost of purchase is calculated as follows (for complete calculations please refer to Annexures)

Annualized Purchase Cost =

$$\frac{p\left(\frac{APR}{N}\right)}{1-(1+\frac{APR}{N})\hat{}-Nt}$$

P= Purchase cost

APR= Interest Rate

N= Number of payments in a year

t= total years

*Therefore, the annualized purchase cost is **2.71 lakh per year.***

Annual fuel cost: To calculate this, three components are needed, fuel efficiency [11]and price of fuel (in this case electricity tariff).

Fuel Efficiency	0.625 kWh/km
Electricity Tariff	7.11[12]
Operations	500 km per day
Operational Days in a year	300

Fuel cost per km= 0.625* 7.11* 4

=17.775 Rs per km

Therefore, the Annual Cost of Fuel= 17.775*500*300

= 26.7 lakh per year

*Therefore, the annualized purchase cost is **2.71 lakh per year.***

Annual Maintenance cost-The annual maintenance cost is assumed to be 0.5 lakh.

Total Annual Cost-The aggregate of all three annual costs i.e., annualised purchase cost, annual fuel cost and annual maintenance cost is total annual cost.

$$= Annualized\ purchase\ cost + annual\ fuel\ cost + annual\ maintenance\ cost$$
$$= 2.71 + 26.7 + 0.5$$
$$= 29.87\ lakh\ per\ year$$

These costs are adjusted for inflation and projected for 10 years and added. The final summation is discounted to net present value resulting in 283.13 lakhs.

ii.) Diesel truck

Using the similar calculation, the annualised purchase cost comes out to be ***2.12 lakhs.***

Annual Fuel Cost

Fuel efficiency	0.125 ltr/km[13]
Price of diesel	46 Rs/ltr[14]
Fuel cost	5.75 Rs/km

[11] Obtained by dividing battery capacity by range per day i.e., 100km per day

[12] Actual Cost of Supply, Tariff order Delhi 2020

[13] Obtained by = 1/ mileage

[14] As of October 2021,https://www.bankbazaar.com/fuel/diesel-price-delhi.html#diesel-price-feb-22

Annual cost	88lakhs

Annual Fuel cost= fuel efficiency* price of diesel* fuel cost
= 0.125*46*5.75
= 8.63 lakhs

i. Annual Maintenance cost: Assumed same for both diesel and electric i.e., 0.5 lakh.

ii. Total Annual Cost: Summation of all three costs above i.e.,

$$= \boldsymbol{Annualized\ purchase\ cost + annual\ fuel\ cost + annual\ maintenance\ cost}$$
$$= \mathbf{2.12 + 8.63 + 0.5}$$
$$= \mathbf{11.25\ lakh\ per\ year}$$

Now, calculating values for all ten years after incorporating 4% inflation on fuel price**.**

Table 4 Year wise cost of diesel truck at base case

Years	1	2	3	4	5	6	7	8	9	10
Annualized Purchase cost (lakhs)	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12
Annual Fuel cost (lakhs)	□ 8.63	□8.97	□ 9.33	□9.70	□10.09	□10.49	□10.91	□11.35	□11.80	□12.28
Annual Maintenance cost (lakhs)	□0.5	□ 0.52	□ 0.54	□ 0.56	□ 0.58	□ 0.61	□ 0.63	□ 0.66	□ 0.68	□ 0.71
Total Annual Cost (lakhs)	**□11.25**	**□11.61**	**□11.99**	**□12.39**	**□12.80**	**□13.23**	**□13.67**	**□14.13**	**□14.61**	**□15.11**

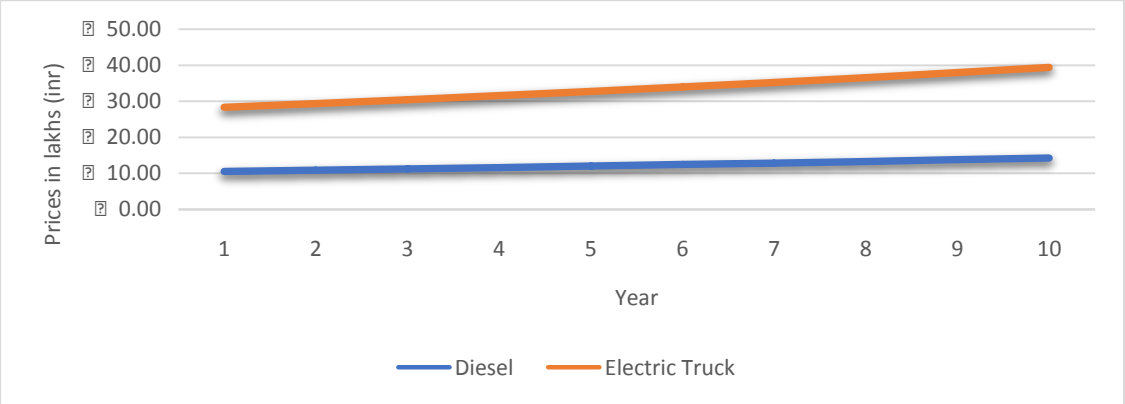
Net Present Value (discounted at inflation) = 104.97

Total Cost of ownership for diesel truck at base case scenario

iii.) Comparative results

In the base case, it is observed that diesel truck is more economical than electric truck. The total cost of ownership of electric truck is 1.69 times the diesel truck. Therefore, in the base case scenario, the rational choice for customer will be diesel truck**.**

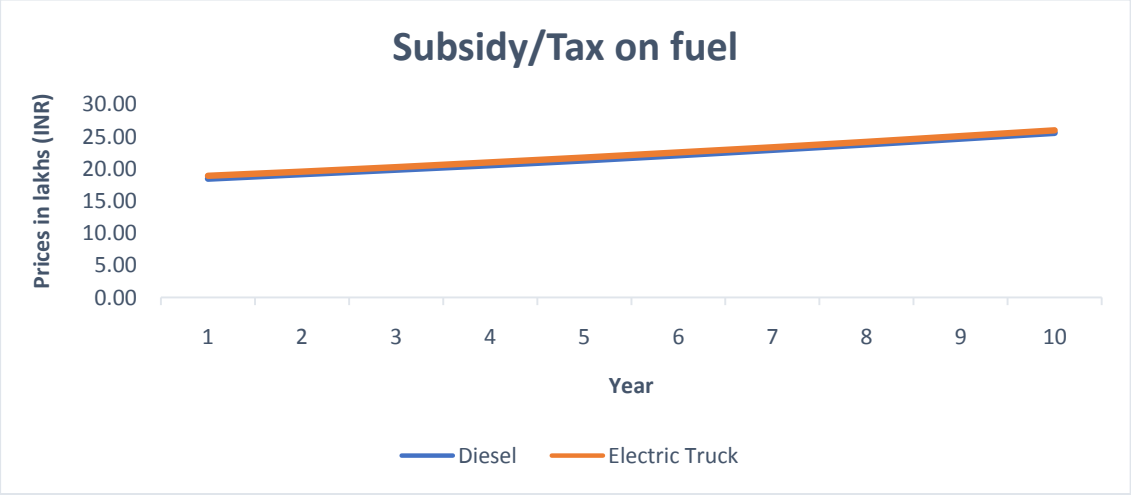
Figure: Base case comparison Diesel vs Electric truck



5.2 Scenario 2 – Taxes and Subsidies on fuel cost

As we have seen in the base case that when no tax and subsidies were added then diesel truck was more economical as compared to electric truck. These trucks despite cheaper than electric vehicle poses several negative externalities to the society such as GHG emission. Hence, to internalise the negative externalities, the government uses standardised methods such as Taxation.

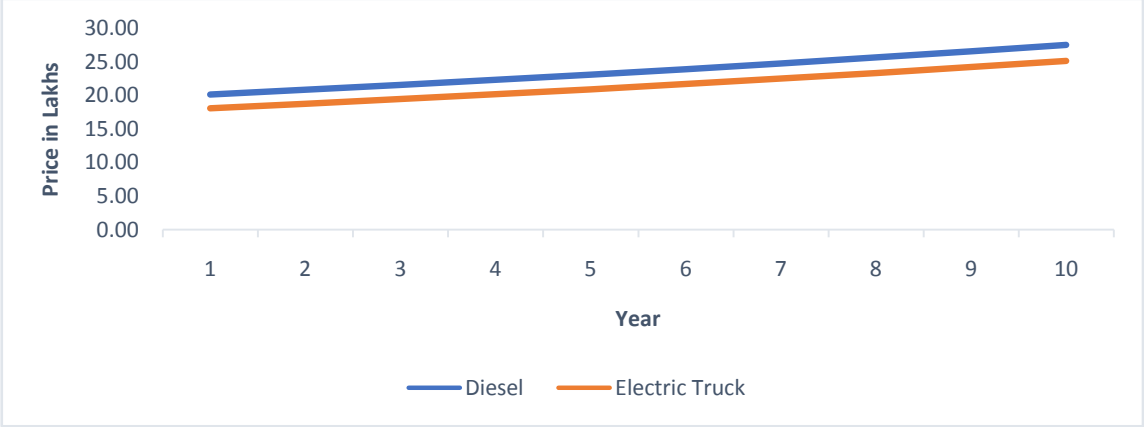
In this case, the taxes and subsidies are applied as per the norms of the Government of India to encourage or discourage certain buying behaviour, keeping upfront costs similar to base case scenario, only fuel costs are altered.



The results obtained indicated that levying taxes and simultaneously subsidizing electricity has significantly lowered the cost of electric truck. The Net Present Value of Electric Truck is slightly (only 2%) higher than diesel truck.

5.3 Scenario 3- As Is case

This case is representative of Government of India's current efforts to increase mass uptake of electric trucks i.e., all the taxes and subsidies currently offered by the government are imposed not only on fuel but on the upfront cost as well.



In this case it can be seen that Indian Government has levied tax on purchase of diesel truck and subsidized the purchase of electric vehicle. These policies clearly proved to be beneficial in long term as NPV or Net present value of diesel truck is more than electric truck by 4% as evident from the above graph shows that diesel truck remain costlier than electric truck throughout the term period.

3. Implications

While the idea of an electric future sounds really enticing on a conceptual level, in reality EVs come with their fair share of concerns for each section of society whether buyer, producer, non-buyer, government, banks etc. The concerns over the nationwide adoption of EVs has been elucidated below:

I. The economic feasibility of e-trucks for that matter any electric vehicle is anchored to the very first argument as to whether it is actually a cleaner, environment- friendly fuel. It is reported that despite claimed being cleaner, EVs still produce considerable amounts of tiny pollution particles from brake and tyre dust, and no safe limit has been accepted for it. These micro-plastics from road surfaces, tyres and brakes will not only enter into the atmosphere, but could find their way into large water bodies such as rivers and eventually seas. Also, these fragments are a substantial contributor to pollution. [15]

Furthermore, EV runs on electricity implying that mass adoption would need unprecedented amounts of electricity surging the global electricity consumption, if not global at least at India level, further implying more

[15] https://www.cppr.in/wp-content/uploads/2019/10/Feasibility-of-Electric-Vehicles-in-India.pdf

usage of coal. However, it has been argued that widespread of renewable can put a dent on coal usage and making EV an absolutely clean alternative. Although such argument does not have a scientific backing therefore, at this stage, EV cannot be considered as a cleaner fuel.

Adding to this, as per various reports, the EVs has high potential to accentuate the global warming levels to twice that of ICE vehicles as it requires extraction of wide range of metals for battery production contributing to carbon emissions.

II. Implications for common man: High cost of electric truck can affect the cost of transportation of cargo ultimately increasing the prices of goods for a common man. However, it can be argued that the nationwide adoption is also possible if OEMs achieve economies of scale, which means lowered cost, implying that cargo price remains at current levels if not decreased. Therefore, based on assumption that economies of scales is achieved, EVs may not negatively affect common man, infact can have positive affects such as low noise and relatively cleaner air.

III. Implications for Government: The shift from conventional vehicle to electric truck requires sourcing of electricity, India already is dependent on imports to meet its coal requirement therefore increased uptake may increase the burden of sourcing coal.

Since, the petroleum products are considered as sin goods therefore, to negate their negative externalities, the government imposes taxes on its consumption. The breakup of price of petrol and diesel are shown in the table below:

Table 5 Breakup of prices of petrol and diesel

Component	**Petrol**		**Diesel**	
	Rs/litre	**% of retail price**	**Rs/litre**	**% of retail price**
Price Charged to Dealers	44.4	42%	46	49%
Excise Duty (levied by centre)	32.9	31%	31.8	34%
Dealer Commission (average)	3.9	4%	2.6	3%
Sales Tax/ VAT (levied by state)	24.3	23%	13.8	15%
Retail Price	**105.5**	**100%**	**94.2**	**100%**

Source; PRS legislative

It can be inferred that price charged to dealers only makes up to 42%, the rest ~50% is accounted for multiple taxes imposed both by central and state governments upon domestic consumption. This 50% component is a revenue for Governments, hence, replacing ICE vehicles by electric vehicles shall act as double edge sword for the Government i.e., cost borne for procuring coal for electricity consumption, importing li-ion batteries, revenue losses on account of taxes since the government is providing heavy subsidies not only as interest subvention in loans in upfront cost but also subsidizing electricity as has been computed in analysis section.

IV. As far as truck owners are concerned, switching to EVs even if it is as cheaper as diesel trucks shall still have many downsides, firstly, underdeveloped technology, the trucks are meant to travel longer hauls on an average 300 km per day (depending on road conditions), with current range of 100 km and charging time of 2 hrs, achieving 300 km distance per day requires charging atleast thrice implying 6 hrs lost in charging, while refuelling diesel truck just requires 5 min (considering 60 ltr diesel tank) with mileage of 8kmpl means 480 km in just one refuelling. This means very high opportunity cost.

Apart from this, electric truck has heavier batteries which takes up more space limiting the amount of cargo that can be carried therefore making trucks less economically feasible for truck owners.

4. Recommendation

It has been seen that government has already reduced the TCO differential at par with diesel trucks, even then the offtake has been neglible therefore based on our analysis it is recommended that:

I. Government should heavily invest in incentivising OEMs across EV value chain. This will let businesses find better solutions to achieve economies of scale further reducing the cost of manufacturing and making EV more economical.

II. Especially for trucks, where charging trucks takes significant time and has added opportunity costs, the government must create a robust charging infrastructure such as battery swapping especially at industrial corridors.

5. Conclusion

Upon analysing the economic feasibility of the electric truck in all three cases it was found that at base case diesel truck is cheaper in comparison to electric truck, in the second scenario after imposing tax on fuel, the cost of both electric truck and diesel truck were almost similar, and in the third scenario the electric truck came out to be cheaper than diesel truck. In this paper, it was seen that Government has managed to reduce the cost differential and made electric trucks cheaper by 4% compared to diesel truck. However, even after these initiatives the penetration of electric technology in freight vehicles is negligible. Within freight vehicles, Light goods vehicle or LGVs has the dominant share around 56% followed by heavy goods vehicle (38%) and rest medium goods vehicle. The technology has not evolved for heavy goods vehicle hence there is no uptake but even in case of LGVs the uptake is reported to be 0.03% which is very low and is a result of strategic decisions of e commerce companies to reduce their carbon footprints. To increase the uptake the government must offer attractive incentives to OEMs rather consumer as TCO has already been reduced comparable to ICE vehicles. and awareness programs must be carried out to curb the safety concerns of the consumers. It is to be noted that even if electric trucks become cheaper in the near future, their uptake will rely heavily on the easy availability of charging infrastructure and safety.

6. Annexures

6.1 Basic overview of the financial model:In the financial model, the upfront costs are calculated along with the subsidies and taxes on purchase costs as per the scenario, and simultaneously fuel costs and maintenance costs are also calculated with or without taxes or subsidies. Then each of these costs is annualized for 10 years by considering inflation of 4% annually on fuel cost. The summation of annualized purchase cost, annualized fuel cost, and annualized maintenance costs is discounted to the present value to obtain the Net Present Value (NPV) which is total cost of ownership of the truck. The summation of these annualized costs is compared in each scenario for each truck.

6.1 Calculations of Scenarios

9.2.1 Base Case: In this case, any subsidy on the purchase of electric trucks, subsidy on fuel costs, and taxes on diesel are not considered.

Electric Truck Calculations:

i. Annualized Purchase Cost

Purchase Cost	15.29 lakh
Subsidy	0%
Post Subsidy Purchase Cost	15.29 lakh
Financing Cost	12%
Term	10
Subsidy on Financing Cost	0%
Subsidized Financing Cost	12%

Annualized Purchase Cost =

$$\frac{p\left(\frac{APR}{N}\right)}{1-(1+\frac{APR}{N})\hat{}-Nt}$$

P= Purchase cost
APR= Interest Rate
N= Number of payments in a year
t= total years

Therefore, the annualized purchase cost is 2.71 lakh per year.

ii. Annual fuel cost

To calculate this, three components are needed, fuel efficiency [16]and price of fuel (in this case electricity tariff).

[16] Obtained by dividing battery capacity by range per day i.e., 100km per day

Fuel Efficiency	0.625 kWh/km
Electricity Tariff	7.11[17]
Operations	500 km per day
Operational Days in a year	300

Fuel cost per km= 0.625* 7.11* 4
=17.775 Rs per km
Therefore, the Annual Cost of Fuel= 17.775*500*300
= 26.7 lakh per year

iii. Annual Maintenance cost- The annual maintenance cost is assumed to be 0.5 lakh as mentioned above.
iv. Total Annual Cost= The aggregate of all three annual costs i.e., annualised purchase cost, annual fuel cost and annual maintenance cost is total annual cost.

$$= Annualized\ purchase\ cost + annual\ fuel\ cost + annual\ maintenance\ cost$$
$$= 2.71 + 26.7 + 0.5$$
$$= 29.87\ lakh\ per\ year$$

This value is adjusted for inflation from second year onwards till the last year of term,
Assuming inflation rate to be 4% per year, therefore, the cost at the end of all ten years are as below.

Table 6: Yearwise cost of electric truck at base case

Years	1	2	3	4	5	6	7	8	9	10
Annualized Purchase cost (lakhs)	□ 2.71	□ 2.71	□ 2.71	□ 2.71	□ 2.71	□ 2.71	□ 2.71	□ 2.71	□ 2.71	□ 2.71
Annual Fuel cost (lakhs)	□ 26.7	□27.7	□ 28.8	□30.0	□31.2	□32.4	□33.7	□35.1	□36.5	□ 37.9
Annual Maintenance cost (lakhs)	□0.5	□ 0.52	□ 0.54	□ 0.56	□ 0.58	□ 0.61	□ 0.63	□ 0.66	□ 0.68	□ 0.71
Total Annual Cost (lakhs)	□ 29.9	□ 31.0	□ 32.1	□33.3	□ 34.5	□ 35.8	□ 37.1	□ 38.5	□ 39.9	□ 41.4

Now, discounting the total annual cost for inflation to present value,
Net Present Value= 283.13 lakhs
This is the total cost of ownership of an electric truck in the base case scenario.

Diesel Truck Calculations

iii. Annualized Purchase Cost

Purchase Cost	12 lakhs
Subsidy/Tax	0%
Post Subsidy Purchase cost	12 lakhs
Financing Cost1	12%
Term	10 years
Subsidy in financing cost	0%
Subsidized financing cost	12%

Using the above calculation, the annualised purchase cost comes out to be *2.12 lakhs.*

iv. Annual Fuel Cost

Fuel efficiency	0.125 ltr/km[18]
Price of diesel	46 Rs/ltr[19]

[17] Actual Cost of Supply, Tariff order Delhi 2020
[18] Obtained by = 1/ mileage
[19] As of October 2021,https://www.bankbazaar.com/fuel/diesel-price-delhi.html#diesel-price-feb-22

Fuel cost	5.75 Rs/km
Annual cost	88lakhs

Annual Fuel cost= fuel efficiency* price of diesel* fuel cost
= 0.125*46*5.75
= *8.63 lakhs*

v. Annual Maintenance cost: Assumed same for both diesel and electric i.e., 0.5 lakh.

vi. Total Annual Cost: Summation of all three costs above i.e.,

$$= Annualized\ purchase\ cost + annual\ fuel\ cost + annual\ maintenance\ cost$$
$$= 2.12 + 8.63 + 0.5$$
$$= 11.25\ lakh\ per\ year$$

Now, calculating values for all ten years after incorporating 4% inflation on fuel price.

Table 7 Year wise cost of diesel truck at base case

Years	1	2	3	4	5	6	7	8	9	10
Annualized Purchase cost (lakhs)	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12
Annual Fuel cost (lakhs)	□ 8.63	□8.97	□ 9.33	□9.70	□10.09	□10.49	□10.91	□11.35	□11.80	□12.28
Annual Maintenance cost (lakhs)	□0.5	□ 0.52	□ 0.54	□ 0.56	□ 0.58	□ 0.61	□ 0.63	□ 0.66	□ 0.68	□ 0.71
Total Annual Cost (lakhs)	□11.25	□11.61	□11.99	□12.39	□12.80	□13.23	□13.67	□14.13	□14.61	□15.11

Net Present Value (discounted at inflation) = 104.97

8.2.3 Tax/Subsidy on Fuel

Electric Truck: As per the EV policy of Delhi, the electricity is subsidized for electric vehicles.

Price of Electricity	4.5 Rs/kWh[20]
Fuel Efficiency	0.625 kWh/km
Fuel Cost	11.25 Rs/km

Annual Fuel cost= fuel efficiency* price of diesel* fuel cost
= 0.625*4.5*11.25
= 16.88 lakhs

Calculating values for all ten years after incorporating 4% inflation on fuel price.

Table 8Yearwise cost after applying taxes and subsidies on electric truck

Years	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Annualized Purchase cost (lakhs)	□ 2.71	□ 2.71	□ 2.71	□ 2.71	□ 2.71	□ 2.71	□ 2.71	□ 2.71	□ 2.71	□ 2.71
Annual Fuel cost (lakhs)	□ 16.9	□17.6	□ 18.3	□19.0	□19.7	□ 20.5	□ 21.4	□ 22.2	□23.1	□ 24.0
Annual Maintenance cost (lakhs)	□0.5	□ 0.52	□ 0.54	□ 0.56	□ 0.58	□ 0.61	□ 0.63	□ 0.66	□ 0.68	□ 0.71
Total Annual Cost (lakhs)	**□ 20.1**	**□ 20.8**	**□ 21.5**	**□22.3**	**□ 23.0**	**□23.8**	**□ 24.7**	**□ 25.6**	**□ 26.5**	**□ 27.4**

The total cost of ownership is,
Net Present Value = 189.02 lakh

[20] https://www.tatapower-ddl.com/corporate/ev-offering-overview#:~:text=Subsidy%20of%20%E2%82%B96%2C000%20is,per%20unit%20(Excluding%20Taxes).

Diesel truck:The diesel fuel is taxed to reduce the negative externalities. Both central and state government levies tax on diesel. The break-up of the diesel cost is as below.

Price Components	Diesel (Rs/ltr)	% Of Retail Price
Price charged to dealers	46	49%
Excise duty (levied by centre)	31.8	34%
Dealer Commission(average)	2.6	3%
VAT (levied by state)	13.8	15%[21]
Total Cost	94.2	100%

As can be seen from the above table, the aggregate tax levied (by central and state) amounts to 49%. Using this in our analysis and ignoring the average dealer commission our calculations.

Price of diesel	90.19
Fuel Efficiency	0.125
Fuel Cost	11.27

Annual Fuel cost= fuel efficiency* price of diesel* fuel cost
Annual Fuel Cost= 16.91 lakhs

Table 9: Yearwise cost after applying taxes and subsidies on diesel truck

Years	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Annualized Purchase cost (lakhs)	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12	□ 2.12
Annual Fuel cost (lakhs)	□ 16.9	□17.6	□ 18.3	□19.02	□19.78	□20.57	□21.40	□22.25	□23.14	□24.07
Annual Maintenance cost (lakhs)	□0.5	□ 0.52	□ 0.54	□ 0.56	□ 0.58	□ 0.61	□ 0.63	□ 0.66	□ 0.68	□ 0.71
Total Annual Cost (lakhs)	**□19.53**	**□20.23**	**□20.96**	**□21.71**	**□22.49**	**□23.31**	**□24.15**	**□25.04**	**□25.95**	**□26.90**

Net Present Value = 184.64
The total cost of ownership for Diesel truck after levying the taxes on diesel is 184.64 lakh.

8.2.3 As -Is Case

Electric Truck: To encourage the purchase of electric vehicle, the government of India has offered various benefits such as exemption from the road tax, subsidy on purchase and etc. The table below shows the break-up of tax benefits offered to scale the purchase of electric trucks.

Tax Components	% Of Upfront cost
Subsidy on Purchase	2% [22]
Interest subvention on Loans	5%
Annual Road tax	0%
Total subsidy	**7%**

Therefore total 7% subsidy is given on upfront cost. Using this to calculate our Annualized purchase cost below,

Purchase Cost	15.29 lakh
Subsidy	7%
Post Subsidy Purchase Cost	14.22 lakh
Financing Cost	12%
Term	10
Subsidy on Financing Cost	5%
Subsidized Financing Cost	12%

*the annualized purchase cost is **1.84 lakh per year.***

The fuel cost will remain same as second scenario *"Tax/Subsidy on Fuel"*. Now putting these values into our model below we calculate the total cost of ownership.

[21] The Delhi Government levies 16.75% VAT on Diesel, https://prsindia.org/theprsblog/petrol-and-diesel-prices
[22] Benefit of Rs 30,000 is given, here in % terms it is 2%.

Table 10Yearwise cost in As-Is case on electric truck

Years	1	2	3	4	5	6	7	8	9	10
Annualized Purchase cost (lakhs)	□ 1.84	□ 1.84	□ 1.84	□ 1.84	□ 1.84	□ 1.84	□ 1.84	□ 1.84	□ 1.84	□ 1.84
Annual Fuel cost (lakhs)	□ 8.63	□8.97	□ 9.33	□9.70	□10.09	□10.49	□10.91	□11.35	□11.80	□12.28
Annual Maintenance cost (lakhs)	□0.5	□ 0.52	□ 0.54	□ 0.56	□ 0.58	□ 0.61	□ 0.63	□ 0.66	□ 0.68	□ 0.71
Total Annual Cost (lakhs)	**□19.2**	**□19.9**	**□20.6**	**□21.4**	**□22.20**	**□23.0**	**□23.8**	**□24.7**	**□25.6**	**□26.6**

Net Present Value = 182 lakhs

Diesel Truck: The road tax and GST on purchase are levied on the trucks the following table shows the percentage of tax levied on upfront cost of diesel truck.

Tax Component	% Of Upfront Cost
Goods and services tax (GST) on purchase	28%
Annual Road Tax	0.2%[23]
Total Tax	28.2%

Now, adding the above tax calculated to the total purchase cost to calculate annualized purchase cost.

Purchase Cost	12 lakhs
Tax	~28%
Post Tax Purchase cost	15.36 lakhs
Financing Cost	12%
Term	10 years
Subsidy in financing cost	0%
Subsidized financing cost	12%

Annualized Purchase Cost= 2.72 lakhs

Calculating Net Present Value, keeping the fuel cost similar as second scenario.

Table 11Yearwise cost in As-Is case on diesel truck

Years	1	2	3	4	5	6	7	8	9	10
Annualized Purchase cost (lakhs)	□ 2.72	□ 2.72	□ 2.72	□ 2.72	□ 2.72	□ 2.72	□ 2.72	□ 2.72	□ 2.72	□ 2.72
Annual Fuel cost (lakhs)	□ 16.9	□17.6	□ 18.3	□19.02	□19.78	□20.57	□21.40	□22.25	□23.14	□24.07
Annual Maintenance cost (lakhs)	□0.5	□ 0.52	□ 0.54	□ 0.56	□ 0.58	□ 0.61	□ 0.63	□ 0.66	□ 0.68	□ 0.71
Total Annual Cost (lakhs)	**□20.13**	**□20.83**	**□21.55**	**□22.30**	**□23.09**	**□23.90**	**□24.75**	**□25.63**	**□26.55**	**□27.50**

Net Present Value= 189.46 lakhs

References

[1]. Cheok, Q., Husaini, N., & Malik Muhammad, N. (2022). Economic feasibility of electric vehicles: A case study. Energy Storage, 4. https://doi.org/10.1002/est2.302

[2]. CoP26: Modi offers 'Panchamrita' concoction for climate conundrum at Glasgow. (n.d.). Retrieved September 23, 2022, from https://www.downtoearth.org.in/news/climate-change/cop26-modi-offers-panchamrita-concoction-for-climate-conundrum-at-glasgow-80001

[3]. Decarbonising India's Transport System: Charting the Way Forward. (n.d.). 40.

[4]. Decarbonising Transport: Redefining Mobility Policies in India | NITI Aayog. (n.d.). Retrieved September 22, 2022, from https://www.niti.gov.in/index.php/decarbonising-transport-redefining-mobility-policies-india

[5]. Gallagher, E. N. and T. G. and K. S. (n.d.). India's policy pathways for deep decarbonisation. ORF. Retrieved September 22, 2022, from https://www.orfonline.org/expert-speak/indias-policy-pathways-for-deep-decarbonisation/

[6]. India Transport Energy Outlook. (2022, July 18). CEEW. https://www.ceew.in/publications/india-transport-energy-use-carbon-emissions-and-decarbonisation

[23] Tax of 2,375 Rs is levied on the purchase, which is ~ 0.2 % of the price of diesel truck considered for our study.

[7]. Junction, T. (n.d.-a). Tata 710 LPT Price in India 2022—Tata 710 LPT Truck Mileage. Truck Junction. Retrieved September 22, 2022, from https://trucks.tractorjunction.com/en/tata-truck/710-lpt
[8]. Junction, T. (n.d.-b). Tata ULTRA T.7 Electric 3900/HSD Truck Price in India 2022—Tata ULTRA T.7 Electric 3900/HSD Truck Mileage. Truck Junction. Retrieved September 22, 2022, from https://trucks.tractorjunction.com/en/tata-truck/ultra-t7-electric-3900hsd
[9]. K., K., Qiu, K., Ribberink, H., &Entchev, E. (2022). Technical and Economic Feasibility of Electrified Highways for Heavy-Duty Electric Trucks [Preprint]. Volume 17: Technology Innovation to Accelerate Energy Transitions. https://doi.org/10.46855/energy-proceedings-8600
[10]. Kumar, M., Shao, Z., Braun, C., &Bandivadekar, A. (n.d.). DECARBONIZING INDIA'S ROAD TRANSPORT: A META-ANALYSIS OF ROAD TRANSPORT EMISSIONS MODELS. 34.
[11]. Petrol and Diesel Prices. (n.d.). PRS Legislative Research. Retrieved September 22, 2022, from https://prsindia.org/theprsblog/petrol-and-diesel-prices
[12]. Roads Transports | Ministry of Road Transport & Highways, Government of India. (n.d.). Retrieved September 23, 2022, from https://morth.nic.in/road-transport
[13]. Society of Indian Automobile Manufactures. (n.d.). Retrieved September 22, 2022, from https://www.siam.in/statistics.aspx?mpgid=8&pgidtrail=14
[14]. Soman, A., Kaur, H., Jain, H., & Ganesan, K. (n.d.). India's Electric Vehicle Transition. 66.
[15]. Srinivasan, S., Chamola, S., Chaturvedi, V., Koti, P. N., Ghosh, P. P., Behera, A., Mathur, R., Shekhar, S., Jain, A., Bali, S., Qamar, S., Kholod, N., Evans, M., & Horowitz, R. (n.d.). Comparison of Decarbonisation Strategies for India's Land Transport Sector: An Inter Model Assessment. 37.
[16]. STATE LEVEL POLICIES. (n.d.). Retrieved September 22, 2022, from https://e-amrit.niti.gov.in/state-level-policies
[17]. Thamarappally, J. (n.d.). Feasibility of Electric Vehicles in India. 5.