Non–Urban E-Bus Business Plan

Exploring the Role of Private Sector as a Catalyst for Accelerating Transition to E-Bus in India.

SHAKTI SUSTAINABLE ENERGY FOUNDATION

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1 Background

A study titled "Exploring the role of the private sector as catalyst for accelerating transitions of Electric Bus (e-bus) in India", has been undertaken as a joint effort by S G Architects (SGA) and knowledge partners for the project: Council of Energy Environment and Water (CEEW) and Institute of Transportation and Development Policy (ITDP) India. The aim of this study is to help iron out any bottlenecks in accelerating electrification of buses operating under State Transport Undertakings (STUs) and State Transport Authority (STA) Permits on non-urban routes and remove any doubts on viability of such vehicles for a win-win situation for both the industry and the government. This study has been undertaken in five states in India, including Kerala, Union Territory (UT) of Ladakh, Madhya Pradesh (MP), Tamil Nadu (TN) and Uttar Pradesh (UP).

This study was undertaken in three stages. The first stage documented the findings from interactions with operators, to identify the gaps and bottlenecks in electrification of stage carriage buses on non-urban routes, especially by private operators. The second stage involved a deep dive into identifying viability gap for operating electric buses on such routes by the operators. This involved data collection on specific routes, developing business models for different electric bus models on such routes and undertaking pilots (on select routes) and deriving findings on the performance of buses. The third stage involved consolidating these findings to identify policy gaps and develop policy recommendations that can help achieve the aim of this study.

This piece reports the findings from the business model development part in the second stage of the study. A total of 27 routes from five geographies were identified for business model development. This report includes the details of the business model as well as its outputs and findings. It lists input values specific to different routes and electric buses, the approach to route selection,

2 Business Model Development and Input Values

This section details the approach and the methodology for development of the business model as well selection of routes for evaluation and the input values used in it.

2.1 Business Model Development Approach and Methodology

The business model development was undertaken in the following three steps

1. Literature review for identifying indicators and their relationship in an e-bus business model. Literature review was also used to identify input values not recorded from observations or from bus manufacturers (OEMs).
2. Constructing the business model framework and developing the model in a spreadsheet format.
3. Development of questionnaire / checklist for recording route and bus model specific data.

The two key outputs of the business model are cost per km (CPK) and earning per km (EPK) for each bus model on each route. The difference between these two provides the profit per km, which can be averaged over the service life of the bus or over specific time periods (for example the loan tenure). After business model was developed, its outputs were validated using existing data on routes operated by existing diesel buses. Route data and the existing diesel bus specific data was input in the model and the outputs were compared with reported CPK and EPK.

2.2 Route Identification

Two broad approaches were used for selection of routes, for e-bus business plan development, in each of the five focus geographies for this study. These are based on stakeholder preference and a matrix-based evaluation criterion. The details of this selection criteria have been presented in Table 1.

Table 1: Route Selection

S.no	Route Selection Approach	Potential reasons/indicators
1	**Stakeholders' preferen**ce - based on prior knowledge, internal selection process already undertaken (as a part of prior effort), other factors like strategic Importance, tourist routes, etc.	Local and route specific knowledge of stakeholders and their assessment in terms of expected profitability and scalability potential, routes. This may also include routes with external benefits such as routes of strategic, political, or administrative importance or routes with high tourism potential (higher potential for catching eyeballs).
2	**Evaluation based** – A set of routes, or a region is identified by the stakeholder and all suggested routes are evaluated using indicators to shortlist about 5 potential routes in each geography. These indicators are:	
a	High Demand (high ridership) or high earning (EPK)	High potential of profitability with electrification helps generating buy in for pilot and assures its longevity and scaling.
b	Route length	Can be operated with minimum charging requirements
c	Routes in network and overlapping route	Allows sharing of charging infrastructure, and this overall reduction in investment requirement

A total of five meetings were conducted with the three OEMs to collect this data. Bus specifications for a total of 16 bus models was collected (8 AC and 8 Non-AC buses). Additionally, follow up meetings were undertaken for any clarifications or corrections. To collect route specific data The study team conducted a total of 30 meetings with **12 operators** from all five geographies, over a period of six months. Broad operational data was used for route selection based on one of the two criteria. Following this detailed data collection was undertaken selected routes. The combined list of all operators, private and public bus companies -STUs / SPVs and government stakeholders with whom meetings were conducted for route selection and data collection have been presented in Table 2.

Table 2: List of Public & Private Bus Companies / Operators

S. No.	State	Private Operator / SPV	Public Operator / Public Company / Government stakeholder / STU / SRTU
1	UT of Ladakh	Mr. Dorje, President of Private Bus operators' Cooperative association Mr. Shamim, Dy director Electric Bus Motor Garage, Kargil Private Bus operators' Cooperative association, Kargil Meeting with Mr. I. Singal CEO SIDCO	Dr. Zulfikar Ali, Dy director at Electric Bus Motor Garage Sh. Saugat Biswas, IAS (Commissioner Secretary RD/Industries/Transport- UT of Ladakh)
2	Tamil Nadu	Mr. Dharamraj - Add Secretary, The Bus & Car Operators Confederation of India (BOCI) and MD Dharamraj Travels	Mr. Vikram Kapur – ACS (From Planning and Development, Government of Tamil Nadu Mr. S. Krishnan, IAS, Additional Chief Secretary, Industries Department, Government of Tamil Nadu
3	Madhya Pradesh	Mr. Vijay & Mr. Pranay Goswami from Vishwas Transport Services Private Bus Operator Mr. Jitendra Rathore (Rinku) from Earth Connect, Private Bus Operator Mr. Pradeep Soni CEO, Dewas City Transport Services Ltd (DCTSL) & SDM, Dewas Mr. Surya Prakash Tiwari CAO, DCTSL	Shri Chandra Mouli Shukla DM, Dewas
4	Uttar Pradesh	Mr. Vinay, Private Bus Operator, UP	Late Sh. PK Bose, Regional Manager (RM), Lucknow, Uttar Pradesh State Road Transport Corporation (UPSRTC) & Managing Director of Lucknow City Transport Services Ltd (LCTSL)
		Mr. Shubham Verma, Private Bus Operator, UP	Mr. Anil Aggarwal, RM, Kanpur, UPSRTC

S. No.	State	Private Operator / SPV	Public Operator / Public Company / Government stakeholder / STU / SRTU
			Dr. Rajender Pensiya, IAS, Director, Directorate of Urban Transport, Government of UP Shri Tarun Visen, Joint Director, Directorate of Urban Transport, Government of UP Smt. Shuchi Karla, Deputy Director, Directorate of Urban Transport, Government of UP
5	Kerala	Mr. Rijas (BOCI member) & Private Bus Operator- Sona travels Mr. Lawrence, BOCI representative, Kerala	Managing Director of Kleen Smart Bus Limited (KSBL) for Kerala

Operational data for 559 routes (520 from UP, 17 from UT of Ladakh, 9 from Kerala, 7 from MP and 6 from TN) was collected using which a total 27 routes (i.e., 5 from UP, 5 from UT of Ladakh, 7 from Kerala, 5 from MP and 5 from TN) were shortlisted for developing the business plan. This data along with the bus specifications collected from the OEMs were used as input values in the model and profit/loss analysis conducted for each route. This section discusses the details of the route and bus specific input and output values, scenario building and findings of the business models from all five geographies.

2.3 Input Values

For the preparation of the business model, close to 80 bus specific, route specific, scenario specific, default values (based on research and literature review) and user inputs have been added in the model to prepare the base model. And a total of eight probable bus models (for electrification of current fleet) have been included in the model. Based on bus and route specific inputs from existing bus models, projections were worked out over the service life of the bus to estimate the future demand of available E-bus models in the market.

This business model includes factors relating to bus specification (battery size, energy consumption, seating capacity, etc.) and operational details (route length, vehicle utilization, fleet utilization, etc.).

The e-bus model specifications which were input in the business model is presented in Table 3, while route specific input values in the model are presented in Table 4 to Table 8.

Table 3: E-Bus Specific Input Values

Parameters	OEM 1 >10.5m E-bus	OEM 1 8.5-10.5m E-bus	OEM 2 >10.5m E-bus	OEM 2 8.5-10.5m E-bus	OEM 2 <8.5m E-bus	OEM 3 >10.5m E-bus	OEM 3 8.5-10.5m E-bus	OEM 3 <8.5m E-bus	Unit
Total bus cost with batteries and GST	1.62 Cr	1.25Cr	1.35Cr	0.94Cr	0.77Cr	1.99Cr	1.68Cr	1.45Cr	₹
Residual value of bus after service life (excluding battery)	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	No.
Service life (years)	12	12	12	12	12	12	12	12	Years
Battery size	265	177	200	150	102	268	199	153	Kw-h
Minimum State of Charge (SoC)	20%	20%	20%	20%	20%	20%	20%	20%	%
Maximum State of Charge (SoC)	95%	95%	95%	95%	95%	95%	95%	95%	%
Charger efficiency	90%	90%	99%	99%	99%	95%	95%	95%	%
Average curb weight of bus (without batteries)	14000	7500	11971	7429	5671	11092	8900	5820	Kg
Average energy density of battery	0.14	0.14	0.14	0.14	0.14	0.13	0.13	0.13	kwh/kg
Average energy consumption with AC	1.31	1.05	1.00	0.80	0.70	1.07	0.88	0.82	kw-h/km
Average energy consumption without AC	1.11	0.84	0.80	0.60	0.50	0.92	0.75	0.72	kw-h/km
End of life capacity of battery	80%	80%	80%	80%	80%	80%	80%	80%	%
Charger capacity	200	200	200	200	200	200	200	200	Kw-h
Average battery efficiency	90%	90%	90%	90%	90%	90%	90%	90%	%
Battery cost per kw/h (excluding GST)	19,050	19,050	19,050	19,050	19,050	19,050	19,050	19,050	₹ /kw-h
Expected battery cost for replacement batteries (per Kw-h) (excluding GST)	14,300	14,300	14,300	14,300	14,300	14,300	14,300	14,300	₹ /Kw-h
Residual value of battery in terms of current percentage of battery cost	40%	40%	40%	40%	40%	40%	40%	40%	₹ /Kw-h
Total seating capacity (non-urban bus)	55	40	55	40	30	55	40	30	No.

Table 4: UT of Ladakh - route specific Input values

Parameters	Route 1	Route 2	Route 3	Route 4	Route 5	Unit
	Leh-Kargil	Leh-Alchi	Leh-Nyoma	Leh-Dahbheema	Leh-Pangong	
Type of bus	11m non-AC Diesel bus	11m non-AC Diesel bus	11m non-AC Diesel bus	11m non-AC Diesel bus	11m non-AC Diesel bus	m
Fuel economy	2.75	4	3	3	2.8	km / litre
Fuel cost	₹ 79.77	₹ 79.77	₹ 79.77	₹ 94.72	₹ 79.77	₹
Bus cost	₹ 40,00,000	₹ 40,00,000	₹ 40,00,000	₹ 40,00,000	₹ 40,00,000	₹
Vehicle utilization[1]	215.5	268	182	189	160	km
Service life	12	12	12	12	12	years
Avg no. of drivers[2]	1.1	1.1	1.1	1.1	1.1	ratio
Avg no. of conductors	1.1	1.1	1.1	1.1	1.1	ratio
Salary of driver	₹ 25,000	₹ 25,000	₹ 25,000	₹ 25,000	₹ 25,000	₹ per month
Salary of conductor	₹ 15,000	₹ 15,000	₹ 15,000	₹ 15,000	₹ 15,000	₹ per month
Admin staff salary[3]	₹ 20,000	₹ 20,000	₹ 20,000	₹ 20,000	₹ 20,000	₹ per month
Servicing, maintenance, insurance, tyre change, etc. including GST	₹ 2,50,000	₹ 2,50,000	₹ 2,50,000	₹ 2,50,000	₹ 2,50,000	₹ per annum
Bus terminal access cost	₹ 68	₹ 68	₹ 68	₹ 68	₹ 68	₹ per day
Average seating capacity	41	41	41	41	41	no.

[1] **Vehicle Utilization** (in km): It is defined as total effective kilometres done per bus on road per day

[2] **Average number of drivers / conductors:** It is the % ratio of number of total drivers / conductors assigned per bus

[3] **Admin staff salary (in ₹ per month):** It is the average salary given to the administrative staff per month

Parameters	Route 1 Leh-Kargil	Route 2 Leh-Alchi	Route 3 Leh-Nyoma	Route 4 Leh-Dahbheema	Route 5 Leh-Pangong	Unit
Average occupancy	53%	86%	50%	55%	86%	%
Total admin staff per bus	0	0	0	0	0	ratio
Annual permit + road tax	₹ 8800	₹ 8800	₹ 8800	₹ 8800	₹ 8800	₹ per annum
Total expected EPK	₹ 65	₹ 43	₹ 50	₹ 54	₹ 65	₹ per km
Route length	215.5	67	182	189	160	km
Current interest rate	14%	14%	14%	14%	14%	%
Current loan duration	4	4	4		4	Years

Table 5: Tamil Nadu- route specific Input values

Parameters	Route 1 Trichy – Pudukkottai	Route 2 Trichy - Ariyalur	Route 3 Trichy - Thurailur	Route 4 Coimbatore - Pollachi	Route 5 Coimbatore - Mothepalayam	Unit
Type of bus	11m non-AC Diesel bus	11m non-AC Diesel bus	11m non-AC Diesel bus	11m non-AC Diesel bus	11m non-AC Diesel bus	m
Fuel economy	4.1	4.1	4.1	4.1	4.1	km / litre
Fuel cost	₹ 94.72	₹ 94.72	₹ 94.72	₹ 94.72	₹ 94.72	₹
Bus cost	₹ 25,70,000	₹ 25,70,000	₹ 25,70,000	₹ 25,70,000	₹ 25,70,000	₹
Vehicle utilization	400	400	400	360	360	km
Service life	6	6	6	6	6	years
Avg no. of drivers	2.4	2.4	2.4	2.4	2.4	ratio
Avg no. of conductors	2.4	2.4	2.4	2.4	2.4	ratio
Salary of driver	₹ 15,500	₹ 15,500	₹ 15,500	₹ 15,500	₹ 15,500	₹ per month
Salary of conductor	₹ 14,500	₹ 14,500	₹ 14,500	₹ 14,500	₹ 14,500	₹ per month
Admin staff salary	₹ 17,500	₹ 17,500	₹ 17,500	₹ 17,500	₹ 17,500	₹ per month
Total maintenance staff per bus	0.5	0.5	0.5	0.5	0.5	ratio
Servicing, maintenance, insurance, tyre change, etc. including GST	₹ 2,50,000	₹ 2,50,000	₹ 2,50,000	₹ 2,50,000	₹ 2,50,000	₹ per annum
Bus terminal access cost	₹ 90	₹ 90	₹ 90	₹ 90	₹ 90	₹ per day
Average seating capacity	50	50	50	50	50	No.

Average occupancy	147%	147%	147%	147%	147%	%
Total admin staff per bus	0.2	0.2	0.2	0.2	0.2	ratio
Annual permit + road tax	₹ 4800	₹ 4800	₹ 4800	₹ 4800	₹ 4800	₹ per annum
Total expected EPK	₹ 42.5	₹ 42.5	₹ 42	₹ 42.5	₹ 42.5	₹ per km
Route length	50	100	50	45	45	km
Current interest rate	9%	9%	9%	9%	9%	%
Current loan duration	4	4	4	4	4	Years

Table 6: Dewas Madhya Pradesh - route specific Input values

Parameters	Route 1 Dewas - Ujjain	Route 2 Dewas - Indore	Route 3 Indore - Shujalpur	Route 4 Indore - Biaora	Route 5 Dewas - Neemuch	Unit
Type of bus	11m non-AC Diesel bus	12m AC Diesel bus	11m non-AC Diesel bus	11m non-AC Diesel bus	11m non-AC Diesel bus	m
Fuel economy	5.5	5	5.5	5	5	Km / litre
Fuel cost	₹ 94.02	₹ 94.02	₹ 94.02	₹ 94.02	₹ 94.02	₹
Bus cost	₹ 22,00,000	₹ 37,00,000	₹ 22,00,000	₹ 22,00,000	22,00,000₹	₹
Vehicle utilization	370	400	360	386	492	km
Service life	10	7	10	10	7	years
Average no. of drivers	2	2	2	2	2	ratio
Average no. of conductors	2	2	2	2	2	ratio
Salary of driver	₹ 15,000	₹ 15,000	₹ 15,000	₹ 15,000	₹ 15,000	₹ per month
Salary of conductor	₹ 10,000	₹ 10,000	₹ 10,000	₹ 10,000	₹ 10,000	₹ per month
Admin staff salary	₹ 20,000	₹ 23,000	₹ 20,000	₹ 20,000	₹ 23,000	₹ per month
Servicing, maintenance, insurance, tyre change, etc. including GST	₹ 2,00,000	₹ 2,00,000	₹ 2,00,000	₹ 2,00,000	₹ 2,00,000	₹ per annum
Average seating capacity	40	46	46	46	46	No.
Average occupancy	90%	75%	87%	87%	87%	%
Total admin staff per bus	5	5	5	5	5	ratio
Annual permit + road tax	₹ 348000	₹ 348000	₹ 348000	₹ 348000	₹ 348000	₹ per annum
Total expected EPK	₹ 45	₹ 50	₹ 44	₹ 44	₹ 44	₹ per km
Route length	37	40	180	193	246	km
Current interest rate	12%	12%	12%	12%	12%	%
Current loan duration	7	7	7	7	7	years

Table 7: Uttar Pradesh - route specific Input values

Parameters	Route 1 Charbagh - Ayodhya	Route 2 Alambagh - Prayagraj	Route 3 Kaisarbagh– Bahraich	Route 4 Charbagh - Kanpur	Route 5 Charbagh - Barabanki	Unit
Type of bus	12 m long non-AC non-urban Diesel bus	12 m long AC non-urban Diesel bus	12 m long non-AC urban Diesel bus	9 m long non-AC non-urban Diesel bus	7 m long non-AC non-urban Diesel bus	m
Fuel economy	4.5	3.5	3.5	5	7.5	Km / litre
Fuel cost	₹ 89.76	₹ 89.76	₹ 89.76	₹ 89.76	₹ 89.76	₹
Bus cost	₹ 2600000	₹ 4000000	₹ 3500000	₹ 2600000	₹ 1900000	₹
Vehicle utilization	276 km	359 km	407 km	407 km	360 km	km
Service life	10	10	10	10	10	years
Avg. no. of drivers	1.18	2.35	2.35	2.35	2.35	ratio
Avg. no. of conductors	1.18	2.35	2.35	2.35	2.35	ratio
Salary of driver	₹ 15000	₹ 15000	₹ 15000	₹ 15000	₹ 15000	₹ per month
Salary of conductor	₹ 12000	₹ 12000	₹ 12000	₹ 12000	₹ 12000	₹ per month
Admin staff salary	₹ 15000	₹ 15000	₹ 15000	₹ 15000	₹ 15000	₹ per month
Maintenance staff salary	₹ 18000	₹ 18000	₹ 18000	₹ 18000	₹ 18000	₹ per month
Total maintenance staff per bus	0.5	0.5	0.5	0.5	0.5	ratio
Servicing, maintenance, insurance, tyre change, etc. including GST	₹ 250000	₹ 250000	₹ 250000	₹ 220000	₹ 180000	₹ per annum
Bus terminal access cost	₹ 150	₹ 150	₹ 150	₹ 150	₹ 150	₹ per day
Average seating capacity	52	40	52	42	28	No.
Average occupancy	48%	53%	34%	68%	82%	%
Total admin staff per bus	0.4	0.4	0.4	0.4	0.4	ratio
Annual permit + road tax	₹ 6700	₹ 6700	₹ 6700	₹ 6700	₹ 6700	₹ per annum
Total expected EPK	₹ 26	₹ 42	₹ 31	₹ 30	₹ 25	₹ per km
Route length	138	208	134	96	41	km
Current interest rate	12%	12%	12%	12%	12%	%
Current loan duration	7	7	7	7	7	years

Parameters	Route 1 Thrissur-Kunnumkulam	Route 2 Aluva-Kothamangalam	Route 3 Thodupuzha-Kottayam	Route 4 Thodupuzha-Pala	Route 5 Thodupuzha-Muvattupuzha	Route 6 Kottayam-Pala	Route 7 Kottayam-Ernakulam	Unit
Type of bus	9m non-AC Diesel bus	9m non-AC Diesel bus	9m non-AC Diesel bus	9m non-AC Diesel) bus	9m non-AC Diesel bus	9m non-AC Diesel bus	9m non-AC Diesel bus	m
Fuel economy	4	4	4	4	4	4	4	Km/ litre
Fuel cost	₹ 96.51	₹ 96.51	6.51	₹ 96.51	₹ 96.51	₹ 96.51	₹ 96.51	₹
Bus cost	₹ 28,00,000	₹ 35,00,000	₹ 43,50,000	₹ 43,50,000	₹ 43,50,000	₹ 43,50,000	₹ 43,50,000	₹
Vehicle utilization	310	280	240	280	240	240	350	km
Service life	15	15	15	15	15	15	15	years
Avg. no. of drivers	1	1	1	1	1	1	1	ratio
Avg. no. of conductors	1	1	1	1	1	1	1	ratio
Salary of driver	₹ 20,000	₹ 25,000	₹ 30,000	₹ 30,000	₹ 30,000	₹ 30,000	₹ 30,000	₹ per month
Salary of conductor	₹ 20,000	₹ 20,000	₹ 30,000	₹ 30,000	₹ 30,000	₹ 30,000	₹ 30,000	₹ per month
Admin staff salary	₹ 3,600	0	₹ 30,000	₹ 30,000	₹ 30,000	₹ 30,000	₹ 23,667	₹ per month
Maintenance staff salary	₹ 1,000	0	0	0	0	0	0	₹ per month
Total maintenance staff /bus	0.2	0	0	0	0	0	0	ratio

Parameters	Route 1 Thrissur-Kunnumkulam	Route 2 Aluva-Kothamangalam	Route 3 Thodupuzha-Kottayam	Route 4 Thodupuzha-Pala	Route 5 Thodupuzha-Muvattupuzha	Route 6 Kottayam-Pala	Route 7 Kottayam-Ernakulam	Unit
Servicing, maintenance etc.	₹ 2,32,500	₹ 2,10,000	₹ 2,40,000	₹ 2,40,000	₹ 2,40,000	₹ 2,40,000	₹ 2,40,000	₹ per annum
Bus terminal access cost	₹ 30	₹ 30	₹ 30	₹ 30	₹ 30	₹ 30	₹ 30	₹ per day
Average seating capacity	38	40	42	36	36	36	36	No.
Average occupancy	90%	90%	90%	90%	90%	90%	90%	%
Total admin staff per bus	0.2	0	1	1	1	1	1	ratio
Annual permit + road tax	₹ 1,39,500	₹ 1,26,000	₹ 1,27,440	₹ 1,27,440	₹ 1,27,440	₹ 1,27,440	₹ 1,27,440	₹ per annum
Total expected EPK	₹ 36	₹ 38	₹ 50	₹ 47.5	₹ 50	₹ 50	₹ 50	₹ per km
Route length	31	35	60	28	20	30	70	km
Current interest rate	10%	10%	10%	10%	10%	10%	10%	%
Current loan duration	5	5	5	5	5	5	5	years

3 Business Model Outputs

The outputs of the business models for all identified routes included estimated average per km profit overall (12 years' service life of bus), during the first four years (during the loan tenure) and during the following eight years. Additional scenarios were defined to simulate policy impact such as subsidies, interest rate waiver, extension of loan tenure, increase in fare, higher attraction of ridership, etc. A comparative analysis was undertaken of outputs in these scenarios to assess the financial viability of switching to electric on these routes by existing operators.

3.1 Scenario Building

The business plan has two components, i.e., cost and earning. For easy understanding, these have been normalised as average CPK and EPK over the service life of the vehicle. Cost includes manpower cost, vehicle, and infrastructure cost (including any interest on the capital), service and maintenance costs, operations cost (fuel expenses, parking expenses) and annual taxes as well insurance cost. Earning currently only accounts for passenger fare, and other sources of income such as advertisement revenue and freight transit earnings, etc. have not been included. However, the passenger fare earning is dependent on the demand as well capacity and therefore the seating capacity[4] of the bus is an important factor in estimating the same. The model uses the existing occupancy percentage as given for all models. However, since this is based on the seating capacity, same occupancy percentage results in varying occupancy in terms of passengers with varying seating capacity of bus. This variation reflects in the EPK and thus the profitability of different bus models evaluated using the business model[5].

A total of eight e-bus models (for electrification of current fleet) have been included (AC or Non-AC) in the business model. A total of six scenarios for the business planning have been developed. Base scenario is the current scenario which includes buses with seating capacity as currently offered by the OEM[6], scenario 1 proposes seating capacity similar to the one observed in current buses (on each route) and is the base scenario for all successive scenarios. Scenarios 2 and 3 are based on increased capacity and increased fare, scenarios 4 and 5 are based on subsidies for capital and energy cost, while scenario 6 is based on reduced interest rates. Scenarios used in the model have been listed below.

- **Base Scenario** – This scenario uses the seating capacity offered by each model as standard
- **Scenario 1** – This scenario, uses increased seat capacity on all e-bus models
- **Scenario 2** – This scenario is based on scenario 1 plus increase in occupancy by 10% over the existing occupancy
- **Scenario 3** – This scenario is based on scenario 2. In addition, it assumes an increase in passenger fare by 10%

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[4] Seating capacity is considered as a parameter and not the overall capacity because the routes being evaluated are non-urban routes.

[5] Where the existing bus model is AC (for diesel bus) the comparative bus model versions are also AC versions. Similarly, where the existing/current bus model is a non-AC variant, non-AC variants of comparative e-bus models have been used in the model.

[6] The current e-bus models are type 1 models designed as per urban specifications with less seats and higher standing capacity. Non-urban type 2 models typically have higher seating capacity as permit conditions on non-urban routes do not allow standing.

- **Scenario 4** – This scenario is based on scenario 1 but considers discounts or subsidies of 15% on cost of bus
- **Scenario 5** – This scenario is based on scenario 4, additionally includes 15% subsidy or discount on per unit cost of electricity
- **Scenario 6** – This scenario is based on scenario 1 and assumes reduced interest rate by 25% (over the current interest rates)

3.2 Route wise business plan

This section presents the business model outputs that comprise the business plan for all routes. The business plan has been presented for separately for each route for all states. It is presented for different scenarios in an ownership model, for each route. It is also presented as a lease model based on scenario 1 for each state. The outputs are presented in a comparative format for different e-bus models.

The draft findings were shared with the operators to gather their feedback. This feedback along with findings of the business model was subsequently shared and discussed with other stakeholders including:

- Bus Manufacturers (OEMs)
- Charging Infrastructure and Service providers such as Tata Power
- Development banks including KFW and World Bank

Based on feedback from stakeholders, additional alterations were made in both bus specific and OEM specific inputs in the business model and final outcomes were shared and presented to the relevant stakeholders who were involved in this study. The outputs shared in this report includes these revisions.

For each route, the project team has also undertaken analysis based on further variations in scenario 6. These variations include discounting the interest rate by 50% and increasing the loan tenure by two years to 6 years. This provides insights into sensitivity to these factors. The analysis has been undertaken in terms of profitability during the loan tenure and after the loan tenure. This is to assess, what conditions and what models help avoid losses during the loan tenure. Losses during the loan tenure are expected to be a big deterrent in electrification for small and medium operators.

Scenario 6a was developed to check for impact of increased loan tenure. As expected, if interest rate remains unchanged the average overall profitability will reduce because the interest burden has increased. Hence to counter this, discount on interest rate needs to be increased. In this scenario the discount on interest rate is taken as 50% (with 6-year loan tenure, up from 4 years in scenario 6). The expectation is that this will help cushion off losses during the loan tenure.

3.2.1 UT of Ladakh

Route details of five routes for which business model has been developed in UT of Ladakh has been presented in Table 9.

Table 9: Route details of UT of Ladakh

S. No.	Origin	Destination	Route Length (Km)
1	Leh	Kargil	215.5
2	Leh	Alchi	67
3	Leh	Nyoma	182
4	Leh	Dahbheema	189
5	Leh	Pangong	160

The per km profit or loss in ownership model for each e-bus model in Scenario 1, for each route of UT of Ladakh have been generated as average per km profit overall, i.e., average over 12 years' service life of bus, average during the first four years (during the loan tenure) and average during the following eight years (after the loan tenure). The same has been presented in Table 10. The details of business plans for each of these routes for all six scenarios has been presented in subsequent sub sections.

Table 10: UT of Ladakh: Per Km Profit/ Loss on each e-bus model in Scenario 1

| Route Names | Parameters | OEM 1 | | OEM 2 | | | OEM 3 | | |
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m E-bus	<8.5m E-bus
Route 1: Leh - Kargil	**Overall Profit / Loss**	**26.76**	**11.99**	**36.55**	**23.43**	**9.70**	**26.40**	**10.72**	**-2.90**
	Avg Profit / Loss in first 4 years (₹/km)	-9.26	-13.25	5.62	2.51	-4.08	-24.14	-31.34	-35.67
	Avg Profit / Loss in last 8 years	62.94	33.41	65.73	44.38	23.30	64.65	43.03	20.76
Route 2: Leh - Alchi	**Overall Profit / Loss**	**9.39**	**2.60**	**16.91**	**9.85**	**3.22**	**- 0.21**	**-9.58**	**-7.52**
	Avg Profit / Loss in first 4 years (₹/km)	-22.76	-21.87	-10.25	-8.78	-11.48	-34.40	-36.26	-37.27
	Avg Profit / Loss in last 8 years (₹/km)	35.29	22.73	38.08	24.89	15.94	26.94	13.65	13.96
Route 3: Leh - Nyoma	**Overall Profit / Loss**	**1.88**	**-5.21**	**11.95**	**5.16**	**-2.70**	**-1.08**	**-9.97**	**-17.60**
	Avg Profit / Loss in first 4 years (₹/km)	-44.98	-40.36	-27.88	-22.10	-23.60	-62.92	-61.93	-60.64
	Avg Profit / Loss in last 8 years (₹/km)	40.50	25.32	43.29	27.48	12.26	42.21	26.13	14.79
Route 4: Leh - Dahbheema	**Overall Profit / Loss**	**8.35**	**-0.65**	**18.31**	**9.88**	**0.65**	**5.95**	**-4.67**	**-13.69**
	Avg Profit / Loss in first 4 years (₹/km)	-35.98	-33.55	-19.41	-15.88	-18.63	-53.20	-54.29	-54.37
	Avg Profit / Loss in last 8 years (₹/km)	46.33	29.70	49.12	31.86	15.27	48.04	30.51	18.26
Route 5: Leh - Pangong	**Overall Profit / Loss**	**14.90**	**3.93**	**25.50**	**14.62**	**4.12**	**10.70**	**-2.35**	**-12.34**
	Avg Profit / Loss in first 4 years (₹/km)	-39.44	-37.33	-20.37	-16.86	-20.56	-60.08	-61.98	-62.42
	Avg Profit / Loss in last 8 years (₹/km)	57.79	37.38	60.58	39.54	25.36	59.50	38.19	23.38

3.2.1.1   Ownership Model for Route 1: Leh-Kargil

The route length of Leh to Kargil route is 215.5 km (refer Figure 1). The average (over the service life of the bus) EPK for this route is ₹ 65/km and the existing profit is ₹ 12.27/Km.
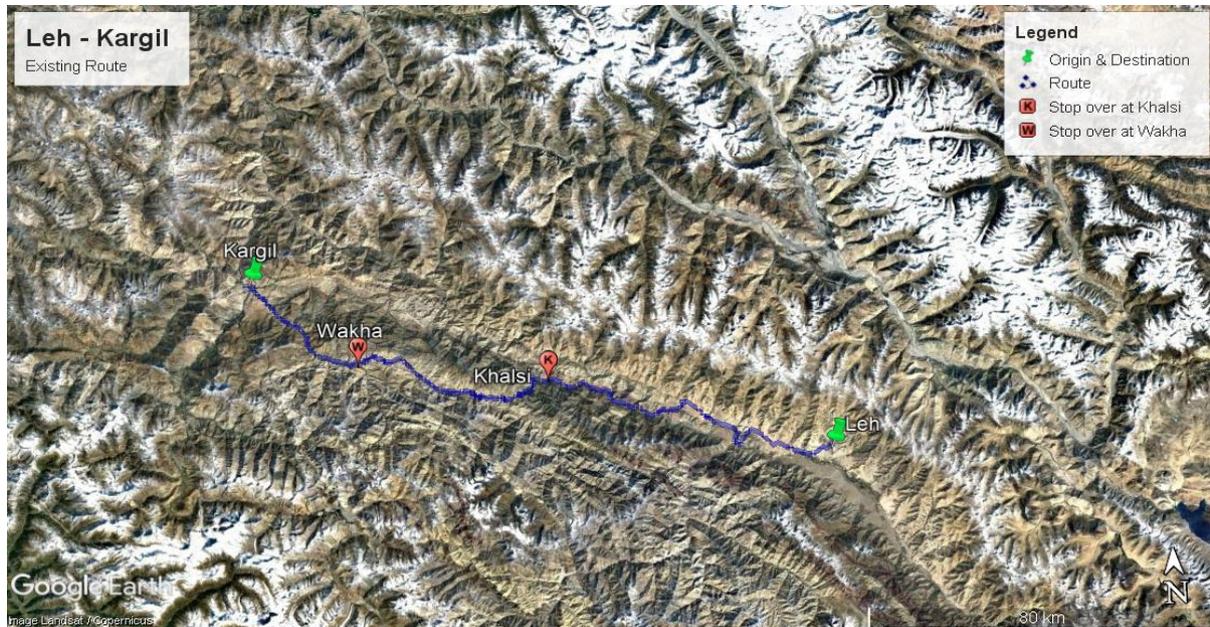
Figure 1: Route Map of existing Leh-Kargil Route

The key findings from the comparative analysis (Figure 2) are:

- In scenario 1, 2, 4, 5 & 6, >10.5m e-bus (for OEM 1, OEM 2 & OEM 3) and 8.5-10.5m e-bus (OEM 2) are profitable
- In scenario 3, all e-bus models are profitable except <8.5m e-bus (OEM 3)
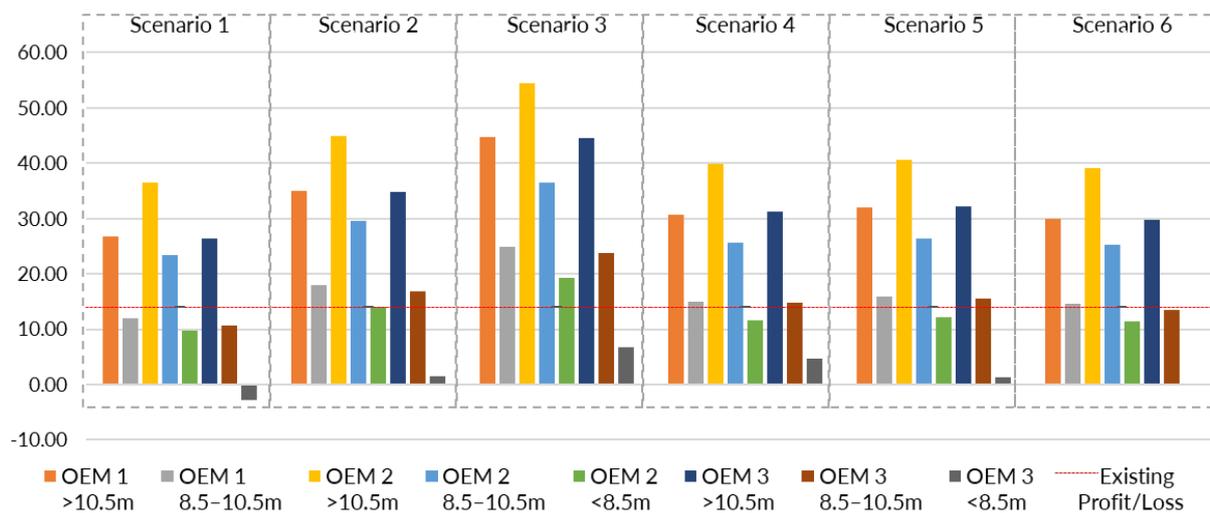
Figure 2: Annual Profitability / Loss on each e-bus model for Leh-Kargil route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, all models except for <8.5m length model for OEM 3 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that >10.5m

and 8.5 to 10.5m length models for OEM2 present average profit during the loan tenure while all other remain unprofitable over this period. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

The findings show that in Scenario 6, all bus models for all OEMs, except for >10.5m and 8.5-10.5m length models for OEM2 post average losses during the loan tenure. However, in scenario 6a, only two models, i.e., <8.5m length and 8.5-10.5m length from OEM 3 remain in loss for the first six years (i.e., during the loan tenure) while all other models are profitable. Table 11 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a

Table 11: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	29.86	14.58	39.05	25.22	11.44	29.67	13.49	-0.25
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-3.08	-8.50	10.76	6.09	-1.16	-16.55	-24.98	-30.22
	Avg Profit / Loss in last 8 years	62.94	34.17	65.73	44.38	23.88	64.65	43.03	21.38
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	18.91	8.39	29.07	18.85	8.18	10.50	-2.32	-10.81
	Avg Profit / Loss in last 6 years	62.94	31.48	65.73	44.38	22.87	64.65	43.03	19.16

3.2.1.2 Ownership Model for Route 2: Leh-Alchi

The route length of Leh to Alchi Route is 67 km (refer Figure 3). The average (over the service life of the bus) EPK for this route is ₹ 43/km and the existing profit is ₹ 5.36/Km.
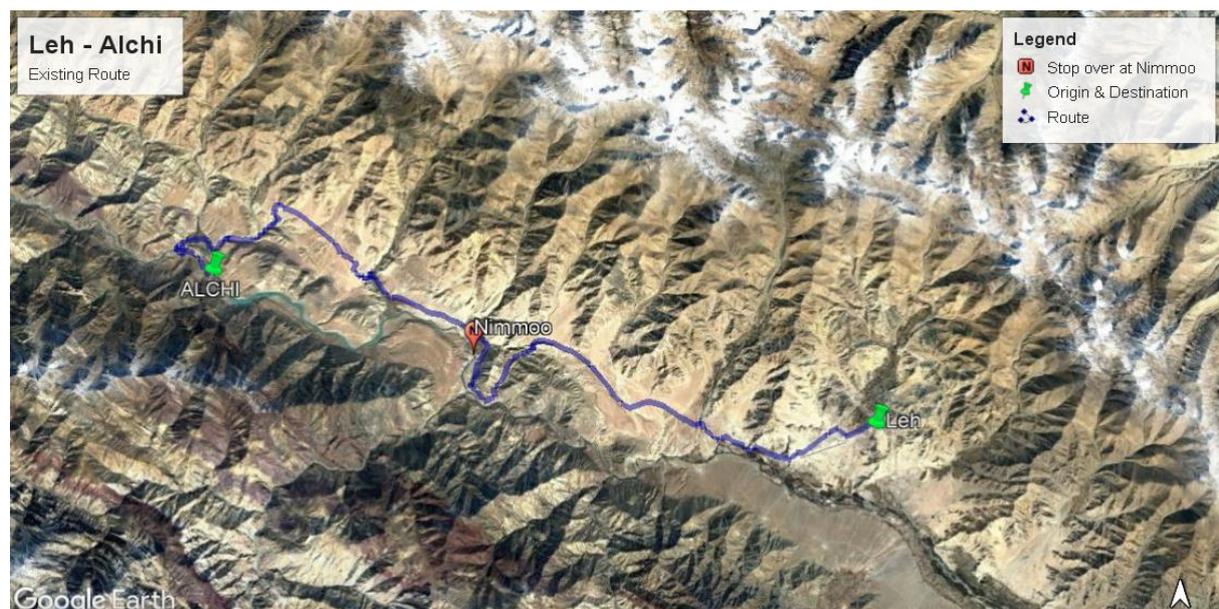

Figure 3: Route Map of existing Leh-Alchi Route

The key findings from the comparative analysis (Figure 4) are:

- In scenario 1, all e-bus models are profitable except OEM's 3 models
- In scenario 2, all e-bus models are profitable except 8.5-10.5m (OEM 3)
- In scenario 3, 4, 5 & 6 all e-bus models are profitable except 8.5-10.5m & <8.5m (OEM 3)
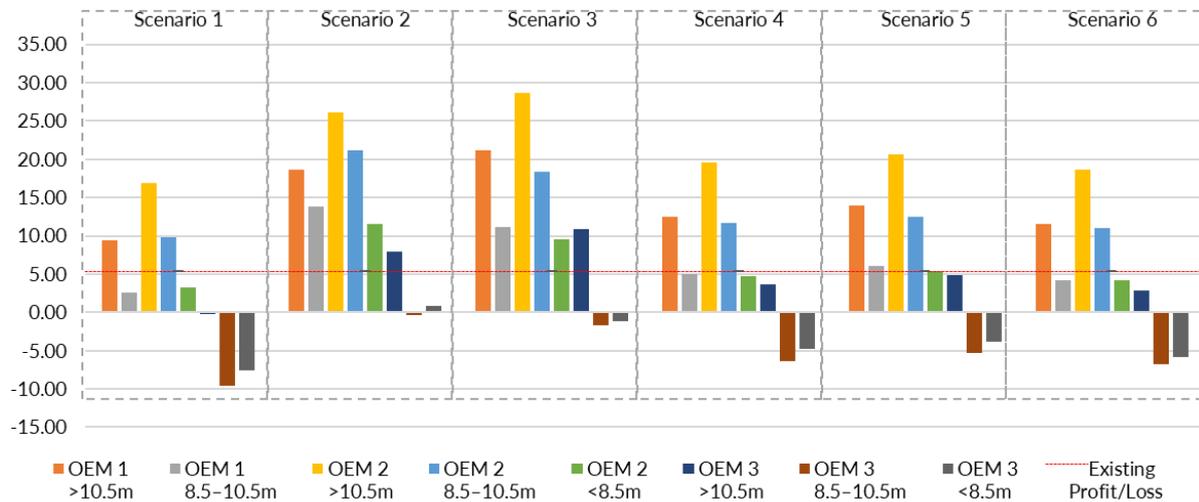
Figure 4: Annual Profitability / Loss on each e-bus model for Leh-Alchi route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, all models except four bus models i.e., 8.5m-10.5m & <8.5M length model for OEM 3 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that all bus models remain unprofitable over this period. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

Whereas, in scenario 6a, six models, i.e., >10.5m from OEM 1&3 <8.5m length from OEM 1, 2&3 and 8.5-10.5m length from OEM 1 & 3 remain in loss for the first six years (i.e., during the loan tenure) while all other models are profitable. Table 12 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a

Table 12: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m E-bus	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	11.52	4.24	18.64	11.05	4.18	2.88	-6.83	-5.81
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-17.88	-18.14	-6.20	-5.98	-9.26	-28.37	-31.22	-33.01
	Avg Profit / Loss in last 8 years	35.20	22.65	37.99	24.81	15.81	27.72	14.42	13.83

| SC :6yrs 50% | 6a & | Avg Profit / Loss in first 6 years | -0.19 | -4.55 | 8.52 | 4.28 | -0.91 | -6.62 | -13.84 | -17.40 |
| | | Avg Profit / Loss in last 6 years | 35.20 | 22.65 | 37.99 | 24.81 | 15.81 | 24.65 | 12.24 | 13.83 |

3.2.1.3 Ownership Model for Route 3: Leh-Nyoma

The route length of Leh to Nyoma Route is 182 km (refer Figure 5). The average (over the service life of the bus) EPK for this route is ₹ 50/km and the existing loss is ₹ -2.66/Km.
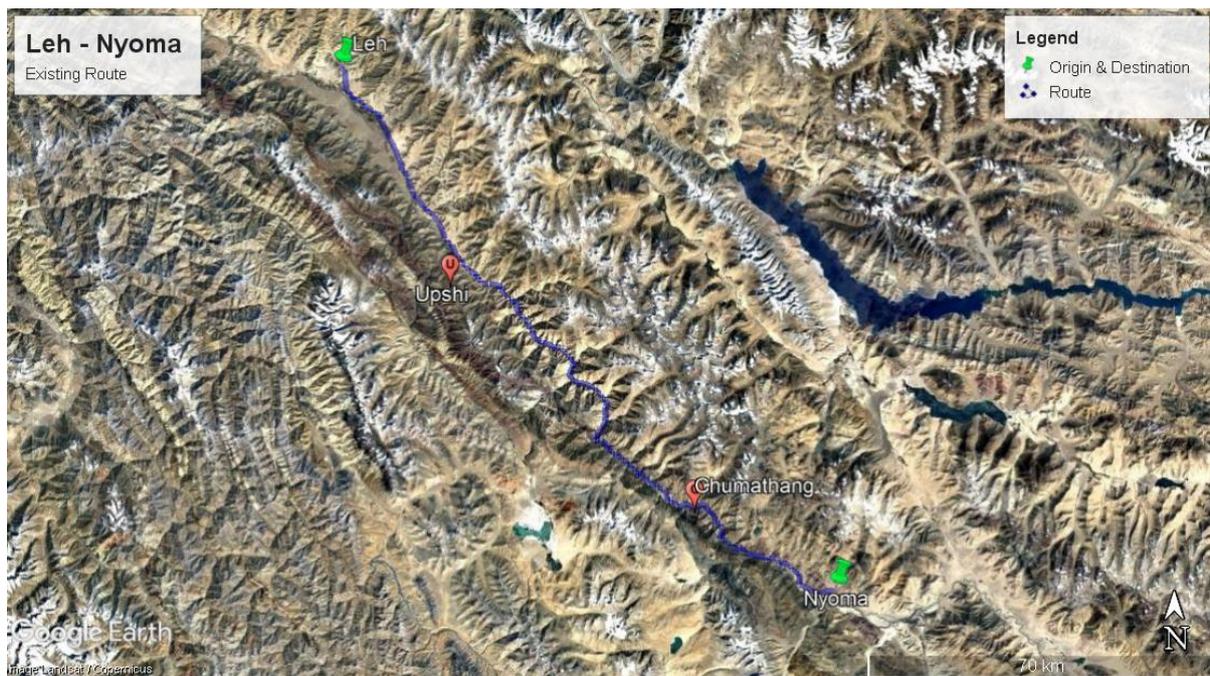
Figure 5: Route Map of existing Leh-Nyoma Route

The key findings from the comparative analysis (Figure 6) are:

- In scenario 1, >10.5m (for OEM 1 & OEM 2) and 8.5-10.5m (OEM 2) are profitable rest of all are in loss
- In scenario 2 & 5 all e-buses models are profitable except 8.5-10.5m (OEM 1), 8.5-10.5m & <8.5m (OEM 3)
- In scenario 3 all e-buses models are profitable except <8.5m (OEM 3)
- In scenario 4 & 6, >10.5m (for OEM 1,2 & 3) and also 8.5m-10.5m (OEM 2) e-buses are profitable rest of all are in loss
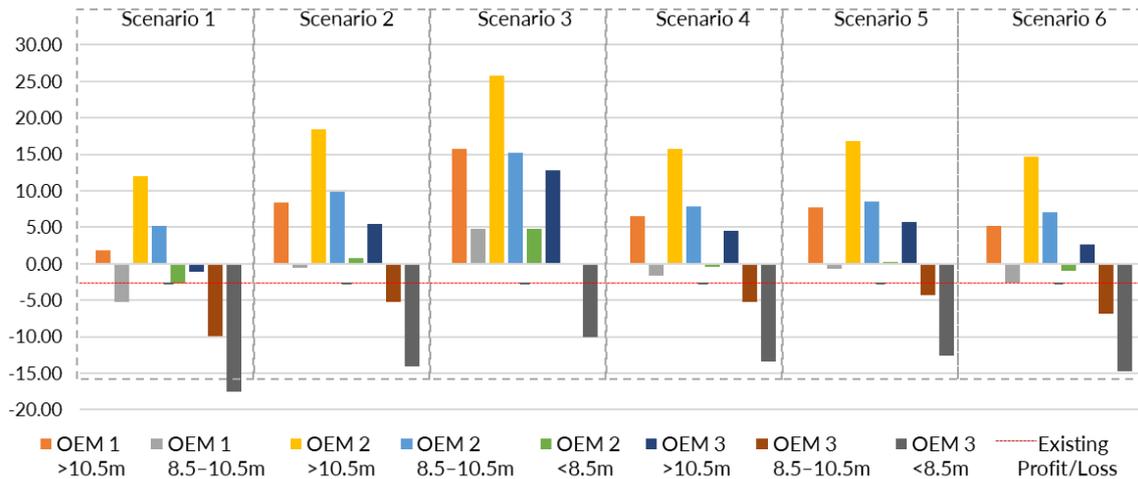
Figure 6: Annual Profitability / Loss on each e-bus model for Leh-Nyoma route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, only >10.5m (for OEM 1,2 &3) and 8.5-10.5m (OEM 2) present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that all models are unprofitable over this period. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

The findings show that in Scenario 6, all bus models for all OEMs, post average losses during the loan tenure. However, in scenario 6a, all models are in loss for the first six years (i.e., during the loan tenure). Table 13 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a

Table 13: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m E-bus	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	5.18	-2.60	14.63	7.07	-0.97	2.62	-6.88	-14.77
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-37.67	-34.74	-21.79	-17.86	-20.08	-53.93	-54.40	-54.12
	Avg Profit / Loss in last 8 years	40.50	25.32	43.29	27.48	12.71	42.21	26.13	14.85
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-11.62	-14.73	-0.11	-2.75	-7.78	-21.90	-27.57	-31.14
	Avg Profit / Loss in last 6 years	40.50	25.32	43.29	27.48	11.33	42.21	26.13	14.85

3.2.1.4 Ownership Model for Route 4: Leh- Dahbheema

The route length of Leh to Dahbheema Route is 189 km (refer Figure 7). The average (over the service life of the bus) EPK for this route is ₹ 54/km and the existing profit is ₹ 2.31/Km.
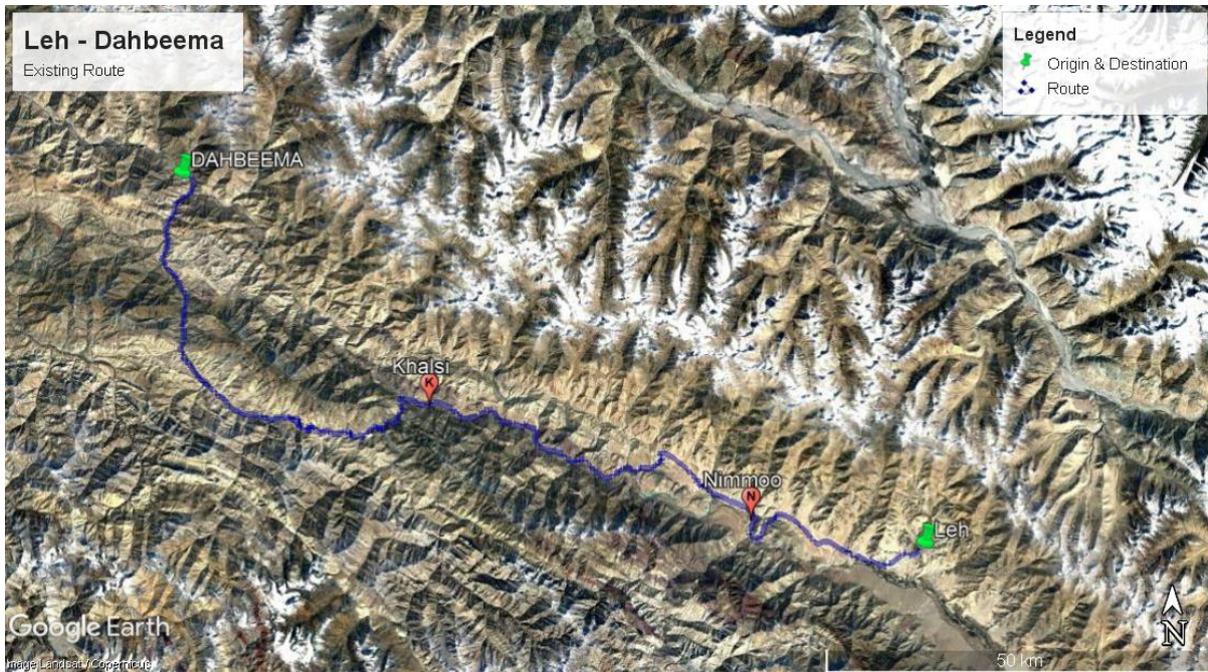
Figure 7: Route Map of existing Leh-Dahbheema Route

The key findings from the comparative analysis (Figure 8) are:

- In scenario 1 & 6 all e-buses models are profitable except 8.5-10.5m &<8.5m (OEM 3)
- In scenario 2, 3, 4 & 5 all e-buses models are profitable except <8.5m (OEM 3)
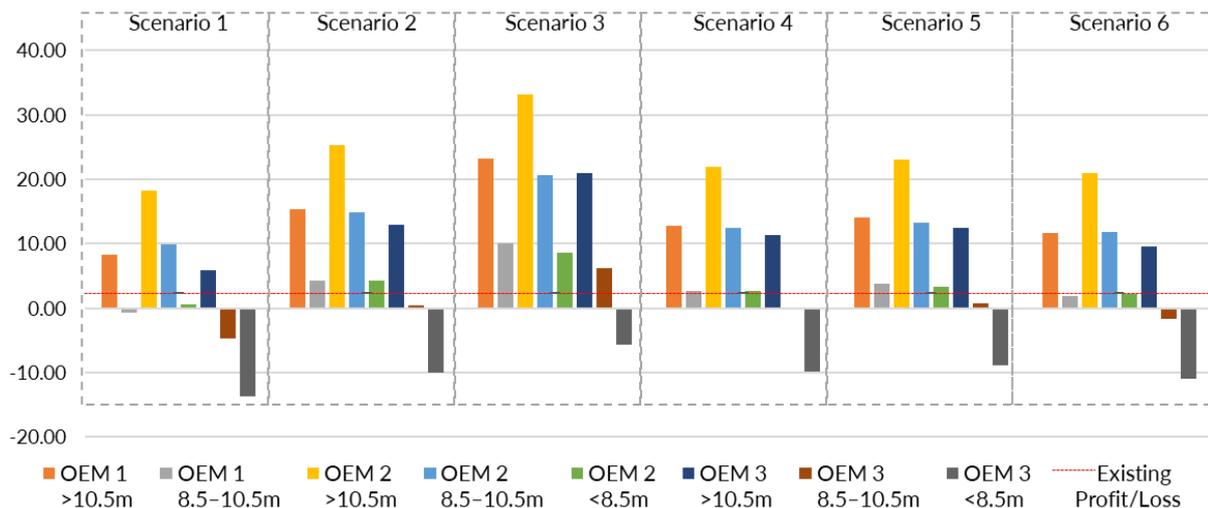
Figure 8: Annual Profitability / Loss on each e-bus model for Leh-Dahbheema route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, all models except 8.5-10.5m & <8.5m length model for OEM 3 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that

all e-bus models present average loss during the loan tenure. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

The findings show that in Scenario 6, all bus models for all OEMs, except for >10.5m and 8.5-10.5m length models for OEM2 post average losses during the loan tenure. However, in scenario 6a, only two models, i.e., <8.5m length and 8.5-10.5m length from OEM 2 are in profit for the first six years (i.e., during the loan tenure) while all other models are in loss. Table 14 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a.

Table 14: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	11.60	1.94	20.94	11.76	2.27	9.55	-1.66	-11.02
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-28.94	-28.14	-13.55	-11.80	-15.37	-44.54	-47.04	-48.22
	Avg Profit / Loss in last 8 years	46.33	29.70	49.12	31.86	15.63	48.04	30.51	18.20
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-3.86	-8.87	7.33	2.74	-3.53	-13.69	-21.20	-26.09
	Avg Profit / Loss in last 6 years	46.33	29.70	49.12	31.86	14.11	48.04	30.51	18.20

### 3.2.1.5   Ownership Model for Route 5: Leh-Pangong

The route length of Leh to Pangong route is 160 km (refer Figure 9). The average (over the service life of the bus) EPK for this route is ₹ 65/km and the existing profit is ₹ 6.86/Km.


Figure 9: Route Map of existing Leh-Pangong Route

The key findings from the comparative analysis (Figure 10) are:

- In scenario 1, all e-buses models are profitable except 8.5-10.5m & <8.5m (OEM 3)
- In scenario 2, 3, 4, 5 & 6 only <8.5m (OEM 3) is unprofitable rest of all are profitable.
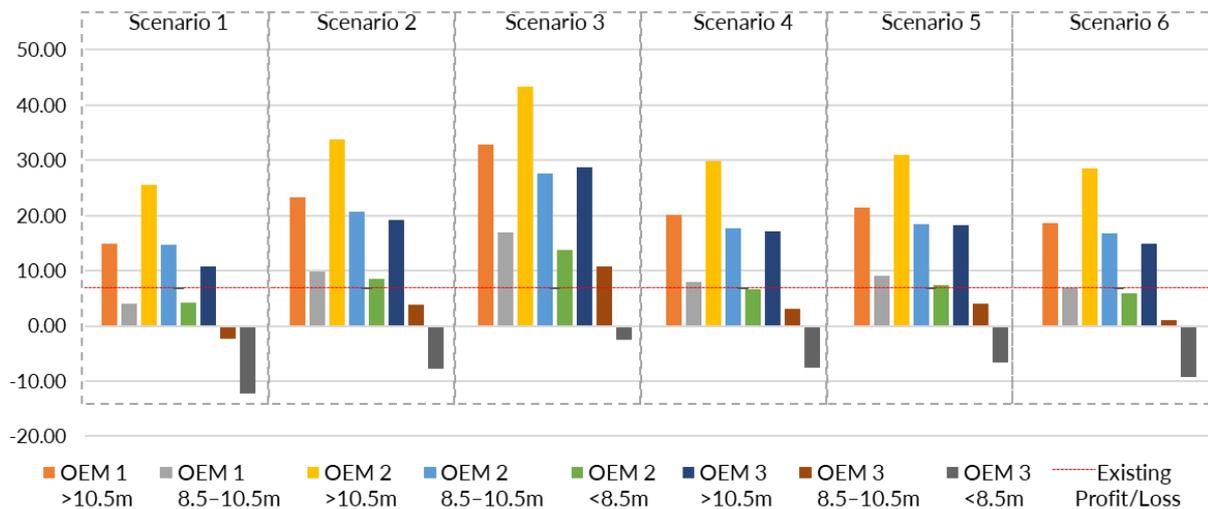

Figure 10: Annual Profitability / Loss on each e-bus model for Leh-Pangong route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, all models except for <8.5m length model for OEM 3 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that all e-bus models are unprofitable over this period. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

The findings show that in Scenario 6, all bus models for all OEMs post average losses during the loan tenure. However, in scenario 6a, only two models, i.e., >10.5m length and 8.5-10.5m length from OEM 2 are profitable for the first six years (i.e., during the loan tenure) while all other models are unprofitable. Table 15 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a

Table 15: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	18.57	6.79	28.50	16.75	5.94	14.88	1.12	-9.28
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-31.12	-30.94	-13.44	-12.03	-16.63	-49.86	-53.41	-55.08
	Avg Profit / Loss in last 8 years	57.79	37.38	60.58	39.54	25.36	59.50	38.19	23.38

Routes									
SC :6yrs 50%	6a &	Avg Profit / Loss in first 6 years	-1.50	-8.18	11.22	5.15	-2.64	-13.42	-22.89	-28.94
		Avg Profit / Loss in last 6 years	57.79	37.38	60.58	39.54	25.36	59.50	38.19	23.38

3.2.1.6 Lease Model for all Routes in Scenario 1

Based on discussion with various private operators, it is understood that operators are keen for alternate modes of ownership to cushion off the impact of initial capital investment. They look forward to a mix of wet and dry lease model where the lessor provides the bus, complete annual maintenance (including, servicing, maintenance, spares, tyres, battery replacement, etc.) and insurance, while the lessee provides the staff, pays for the energy, and pays any taxes/permit fees etc. Table 16 presents the expected maximum, lease cost per km for each of the routes in UT of Ladakh, with a promised minimum average km of operations. It is estimated that at this price the operator will be able to make an average profit of ₹ 4.50 per km throughout the service life of the bus.

Table 16: UT of Ladakh: Maximum Cost for Lease Models of E-Buses

Routes	Min. assured km per annum for each bus (In KM)	OEM 1 - E-bus (Lease cost in ₹ / km)		OEM 2 - E-bus (Lease cost in ₹ / km)			OEM 3 - E-bus (Lease cost in ₹ / km)		
		>10.5m	8.5-10.5m	>10.5m	8.5-10.5m	<8.5m	12m	8.5m	<8.5m
Leh - Kargil	74,725	63.30	42.25	66.09	44.41	29.65	65.01	43.06	27.67
Leh - Alchi	92,929	34.70	21.87	37.49	24.03	14.76	36.41	22.68	12.78
Leh - Nyoma	63,109	41.76	26.18	44.55	28.34	17.23	43.47	26.99	15.25
Leh - Dahbheema	65,536	47.38	30.36	50.17	32.52	20.45	49.09	31.17	18.47
Leh - Pangong	55,480	59.85	38.97	62.64	41.13	26.50	61.56	39.78	24.52

3.2.2 Tamil Nadu

Route details of five routes for which business model has been developed in Tamil Nadu has been presented in Table 17.

<div align="center">

Table 17: Route details of Tamil Nadu

</div>

S. No.	Origin	Destination	Route Length (Km)
1	Trichy	Pudukkottai	50
2	Trichy	Ariyalur	100
3	Trichy	Thurailur	50
4	Coimbatore	Pollachi	45
5	Coimbatore	Methupalayam	45

The per km profit or loss in ownership model for each e-bus model in Scenario 1, for each route of Tamil Nadu have been generated as average per km profit overall, i.e., average over 12 years' service life of bus, average during the first four years (during the loan tenure) and average during the following eight years (after the loan tenure). The same has been presented in Table 18. The details of business plans for each of these routes for all six scenarios has been presented in subsequent sub sections.

Table 18: Tamil Nadu: Per Km Profit/ Loss on each e-bus model in Scenario 1

Route Names	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m E-bus	<8.5m E-bus
Route 1: Tiruchi - Pudukkottai	**Overall Profit / Loss**	**-2.43**	**-9.82**	**4.02**	**0.33**	**1.44**	**1.26**	**-5.63**	**-14.49**
	Avg Profit / Loss in first 4 years (₹/km)	-14.76	-18.3	-5.94	-5.98	-8.28	-21.99	-24.45	-28
	Avg Profit / Loss in last 8 years	13.94	5.42	18.08	10.32	10.09	19.36	9.7	0.64
Route 2: Tiruchi - Ariyalur	**Overall Profit / Loss**	**-2.43**	**-9.82**	**4.02**	**0.33**	**1.44**	**1.26**	**-5.63**	**-14.49**
	Avg Profit / Loss in first 4 years (₹/km)	-14.76	-18.3	-5.94	-5.98	-8.28	-21.99	-24.45	-28
	Avg Profit / Loss in last 8 years (₹/km)	13.94	5.42	18.08	10.32	10.09	19.36	9.7	0.64
Route 3: Tiruchi-Thuraiyur	**Overall Profit / Loss**	**-2.43**	**-9.82**	**4.02**	**0.33**	**1.44**	**1.26**	**-5.63**	**-14.49**
	Avg Profit / Loss in first 4 years (₹/km)	-14.76	-18.3	-5.94	-5.98	-8.28	-21.99	-24.45	-28
	Avg Profit / Loss in last 8 years (₹/km)	13.94	5.42	18.08	10.32	10.09	19.36	9.7	0.64
Route 4: Coimbatore Pollachi	**Overall Profit / Loss**	**-2.06**	**-8.05**	**4.57**	**0.58**	**-7.14**	**-12.40**	**-6.76**	**-13.95**
	Avg Profit / Loss in first 4 years (₹/km)	-20.12	-19.42	-10.1	-9.12	-13.4	-30.23	-29.92	-31.02
	Avg Profit / Loss in last 8 years (₹/km)	15.81	5.72	18.9	10.69	3.07	11.13	9.71	0.85
Route 5: Coimbatore Mothepalayam	**Overall Profit / Loss**	**-2.06**	**-8.05**	**4.57**	**0.58**	**-7.14**	**-12.40**	**-6.76**	**-13.95**
	Avg Profit / Loss in first 4 years (₹/km)	-20.12	-19.42	-10.1	-9.12	-13.4	-30.23	-29.92	-31.02
	Avg Profit / Loss in last 8 years (₹/km)	15.04	5.72	18.9	10.69	3.07	11.13	9.71	0.85

3.2.2.1 Ownership Model for Route 1: Tiruchi – Pudukkottai

The route length of Tiruchi to Pudukkottai route is 50 km (refer Figure 11). The average (over the service life of the bus) EPK for this route is ₹ 42.5/km and the existing profit is ₹ 8.07/Km.
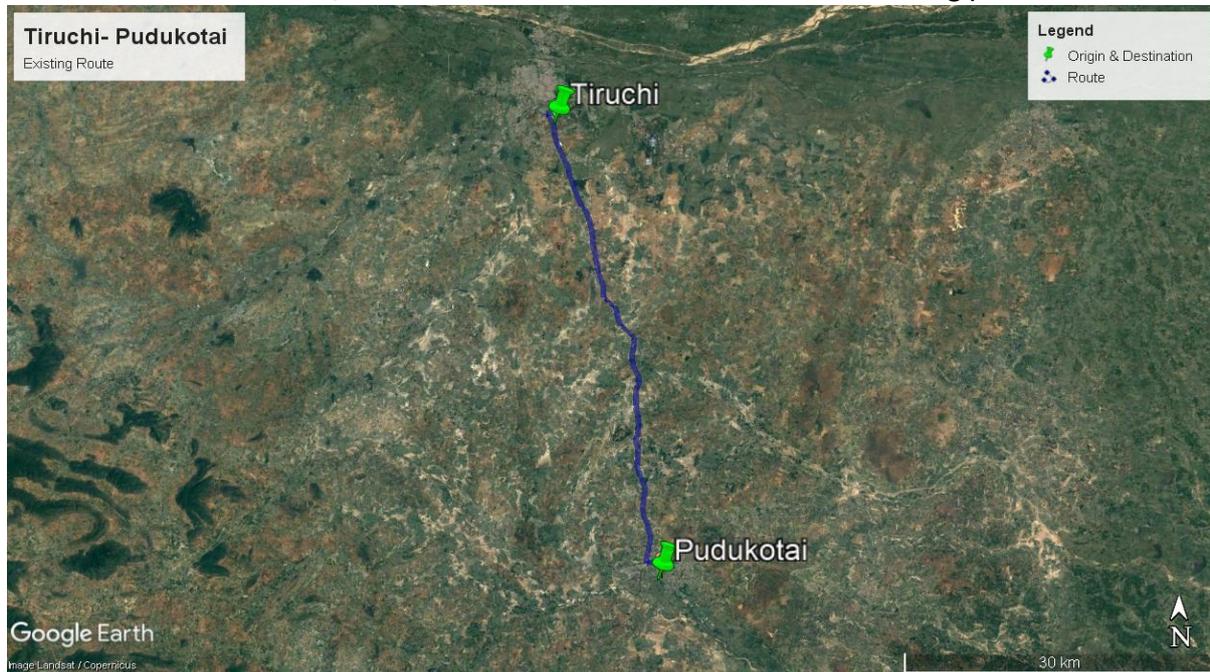
Figure 11: Route Map of existing Tiruchi-Pudukkottai Route

The key findings from the comparative analysis (Figure 12) are:

- In scenario 1 & 4, >10.5m (OEM 3) & OEM 2 all models are profitable
- In scenario 3, all e-bus models are profitable except 8.5-10.5m (OEM 1) and <8.5m (OEM 3)
- In scenario 2, 5 & 6 all e-bus models are profitable except 8.5-10.5m (OEM 1) and 8.5-10.5m, <8.5m (OEM 3)
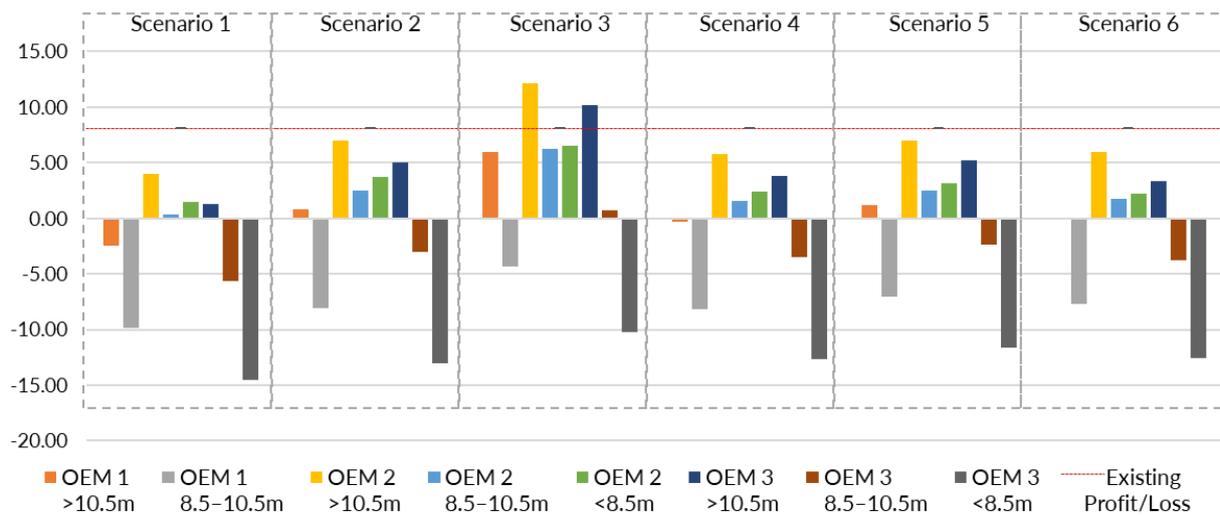
Figure 12: Annual Profitability / Loss on each e-bus model for Tiruchi – Pudukkottai route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, all models except for >10.5m & 8.5m-10.5m length model for OEM 1 and 8.5m-10.5m length and <8.5m length model for OEM 3 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that all bus models remain unprofitable over this period. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

However, in scenario 6a, only two models, i.e., >10.5m length and 8.5-10.5m length from OEM 3 remain profitable for the first six years (i.e., during the loan tenure) while all other models are showing losses. Table 19 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a

Table 19: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	-0.16	-7.71	5.98	1.75	2.18	3.36	-3.81	-12.56
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-11.44	-15.47	-3.13	-4.02	-6.71	-17.91	-21.03	-24.92
	Avg Profit / Loss in last 8 years	14.81	6.22	18.83	10.89	10.09	19.92	10.20	1.27
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-1.90	-8.24	4.19	0.95	-1.11	-3.33	-8.82	-16.19
	Avg Profit / Loss in last 6 years	14.01	6.22	18.83	10.89	10.09	17.94	8.40	1.27

3.2.2.2 Ownership Model for Route 2: Tiruchi – Ariyalur

The route length of Tiruchi to Ariyalur route is 100 km (refer Figure 13). The average (over the service life of the bus) EPK for this route is ₹ 42.5/km and the existing profit is ₹ 8.07/Km.

The key findings from the comparative analysis (Figure 14) are:

- In scenario 1 & 4, >10.5m (OEM 3) & OEM 2 all models are profitable
- In scenario 3, all e-bus models are profitable except 8.5-10.5m (OEM 1) and <8.5m (OEM 3)
- In scenario 2, 5 & 6 all e-bus models are profitable except 8.5-10.5m (OEM 1) and 8.5-10.5m, <8.5m (OEM 3)
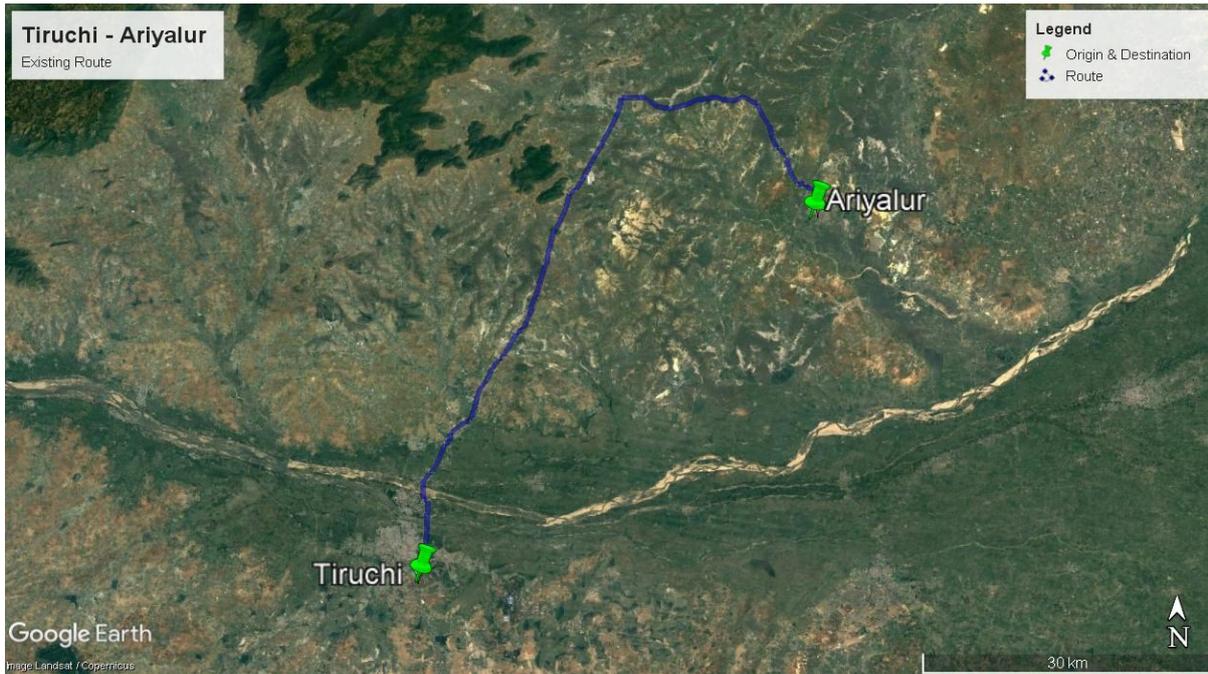
Figure 13: Route Map of existing Tiruchi-Ariyalur Route
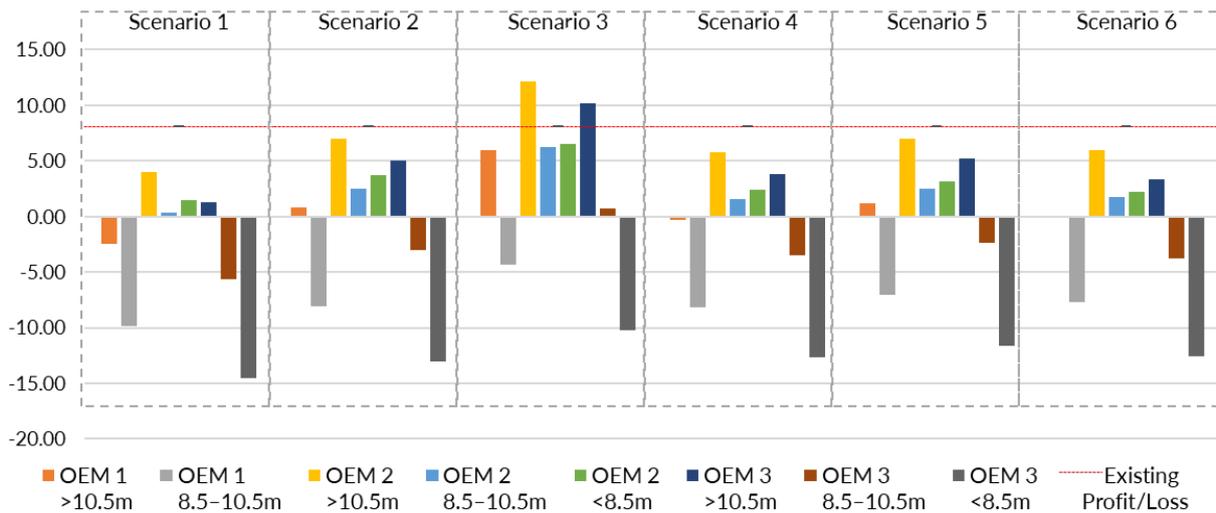
Figure 14: Annual Profitability / Loss on each e-bus model for Tiruchi to Ariyalur route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, all models except for >10.5m and 8.5 to 10.5m length models for OEM 1 and 8.5-10.5m length & <8.5m length from OEM 3 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that none of the bus models become profitable over this period. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

Whereas in scenario 6a, only two models, i.e., >10.5m length and 8.5-10.5m length from OEM 2 become profitable for the first six years (i.e., during the loan tenure) while all other models are in losses. Table 20 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a.

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	-0.16	-7.71	5.98	1.75	2.18	3.36	-3.81	-12.56
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-11.44	-15.47	-3.13	-4.02	-6.71	-17.91	-21.03	-24.92
	Avg Profit / Loss in last 8 years	14.81	6.22	18.83	10.89	10.09	19.92	10.20	1.27
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-1.90	-8.24	4.19	0.95	-1.11	-3.33	-8.82	-16.19
	Avg Profit / Loss in last 6 years	14.01	6.22	18.83	10.89	10.09	17.94	8.40	1.27

3.2.2.3   Ownership Model for Route 3: Tiruchi-Thurailur

The route length of Tiruchi to Thurailur route is 50 km (refer Figure 15). The average (over the service life of the bus) EPK for this route is ₹ 42.5/km and the existing profit is ₹ 8.07/Km.
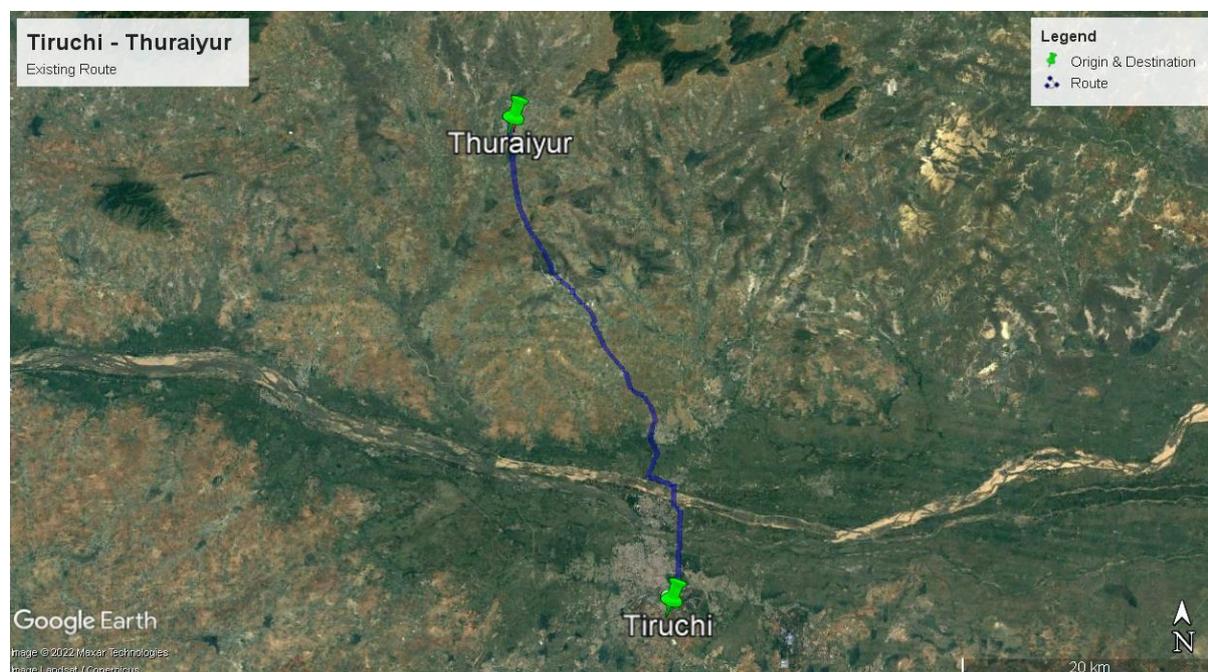
Figure 15: Route Map of existing Tiruchi-Thurailur Route

The key findings from the comparative analysis (Figure 16) are:

- In scenario 1 & 4, >10.5m (OEM 3) & OEM 2 all models are profitable

- In scenario 3, all e-bus models are profitable except 8.5-10.5m (OEM 1) and <8.5m (OEM 3)
- In scenario 2, 5 & 6 all e-bus models are profitable except 8.5-10.5m (OEM 1) and 8.5-10.5m, <8.5m (OEM 3)
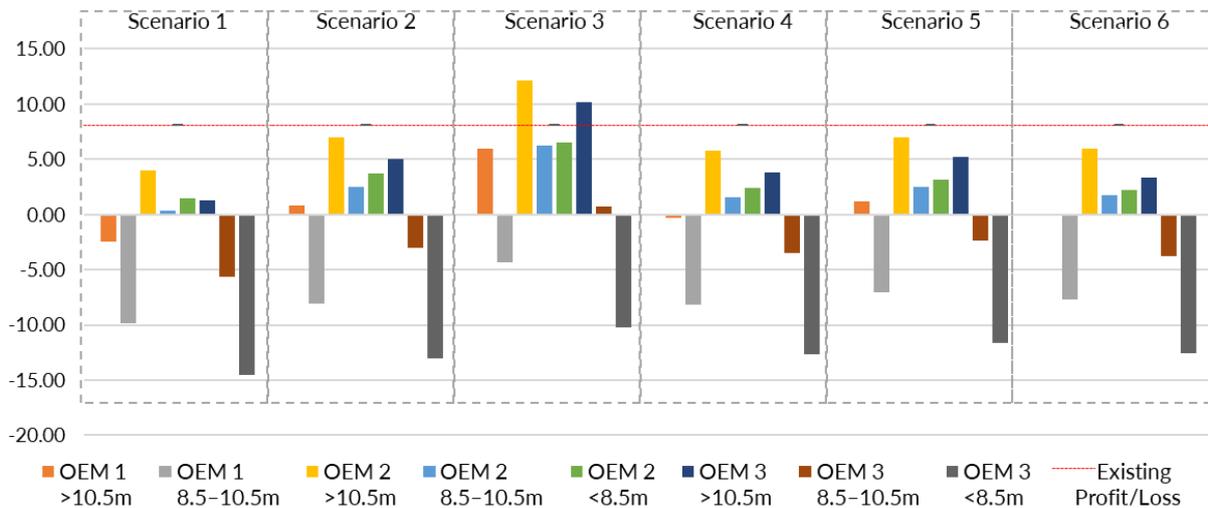

Figure 16: Annual Profitability / Loss on each e-bus model for Tiruchi to Ariyalur route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, all models except for >10.5m and 8.5 to 10.5m length models for OEM 1 and 8.5-10.5m length & <8.5m length from OEM 3 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that all bus models present remain unprofitable over this period. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

Whereas, in scenario 6a, except two models, i.e., >10.5m length and 8.5-10.5m length from OEM 2, all other remains in losses for the first six years (i.e., during the loan tenure) while all other models are profitable. Table 21 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a.

Table 21: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	-0.16	-7.72	5.97	1.75	2.17	3.35	-3.82	-12.57
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-11.44	-15.47	-3.13	-4.02	-6.71	-17.91	-21.03	-24.92
	Avg Profit / Loss in last 8 years	14.81	6.22	18.83	10.89	10.09	19.92	10.20	1.27

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-1.90	-8.24	4.19	0.95	-1.11	-3.33	-8.82	-16.19
	Avg Profit / Loss in last 6 years	14.01	6.22	18.83	10.89	10.09	17.94	8.40	1.27

3.2.2.4 Ownership Model for Route 4: Coimbatore Pollachi

The route length of Coimbatore to Pollachi route is 45 km (refer Figure 17). The average (over the service life of the bus) EPK for this route is ₹ 42.5/km and the existing profit is ₹ 6.81/Km.
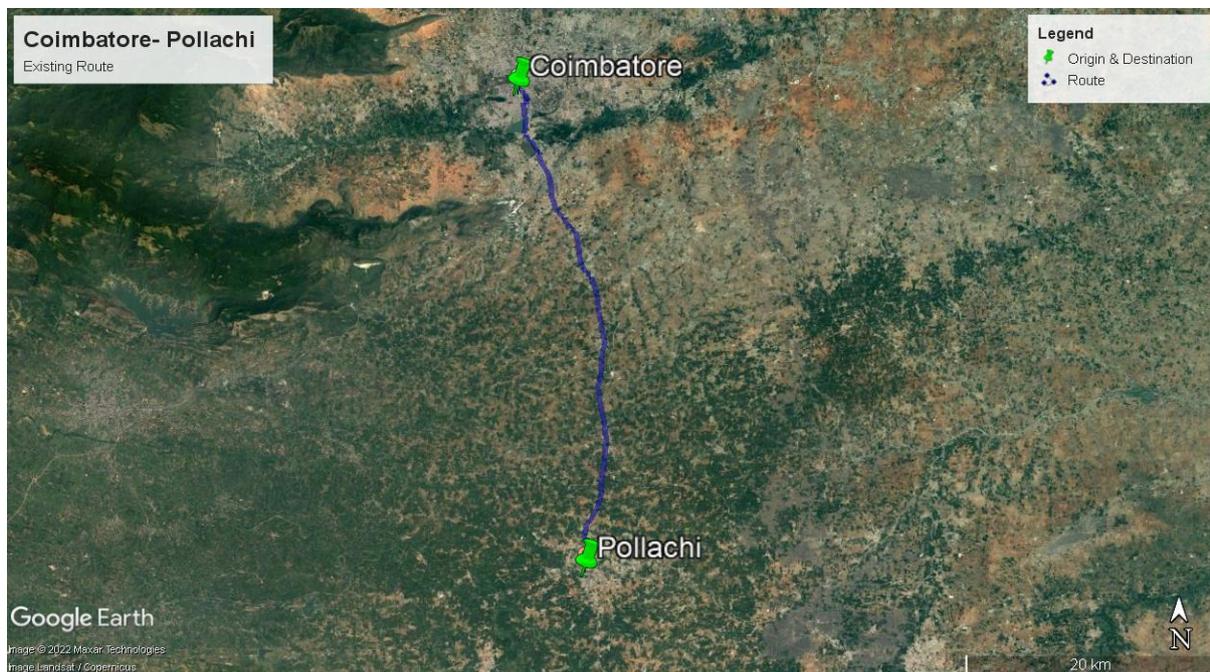
Figure 17: Route Map of existing Coimbatore-Pollachi Route

The key findings from the comparative analysis (Figure 18) are:

- In scenario 1, only >10.5m & 8.5-10.5m (OEM 2) models are profitable
- In scenario 2, 3, 4, 5 & 6 only >10.5m, 8.5-10.5m (OEM 1) & 8.5-10.5m (OEM 2) models are profitable
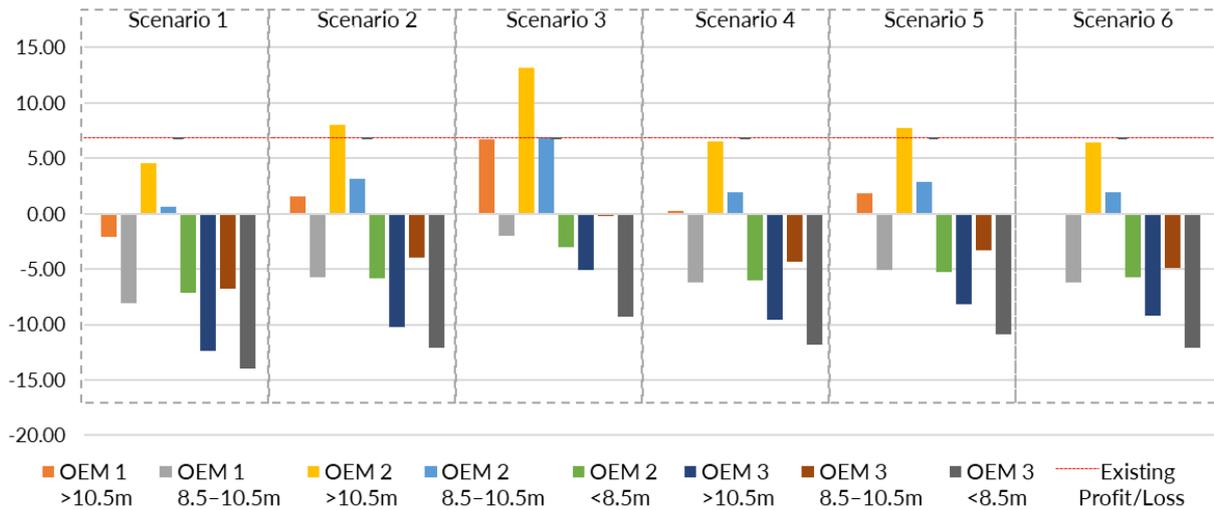
Figure 18: Annual Profitability / Loss on each e-bus model for Coimbatore Pollachi route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, only 3 bus models except i.e., 8.5m-10.5m length from OEM 1, >10.5m length and 8.5-10.5m length bus model for OEM 3 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that none of the bus models are profitable during the loan tenure period. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

Whereas, in scenario 6a, except two models, i.e., >10.5m length from OEM 2 and 8.5-10.5m length from OEM 3, all other bus models remain in loss for the first six years (i.e., during the loan tenure). Table 22 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a

Table 22: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	0.09	-6.18	6.39	1.89	-5.75	-9.22	-4.93	-12.15
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-16.43	-16.58	-7.02	-6.98	-11.48	-25.52	-26.11	-27.76
	Avg Profit / Loss in last 8 years	15.72	6.40	19.49	11.14	3.58	12.29	10.12	1.38
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-3.26	-8.66	3.91	0.61	-6.46	-12.93	-12.55	-17.34
	Avg Profit / Loss in last 6 years	13.26	6.14	17.39	9.58	3.58	12.29	8.63	0.67

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3.2.2.5   Ownership Model for Route 5: Coimbatore - Mothepalayam

The route length of Coimbatore to Mothepalayam route is 45 km (refer Figure 19). The average (over the service life of the bus) EPK for this route is ₹ 42.5/km and the existing profit is ₹ 6.81/Km.
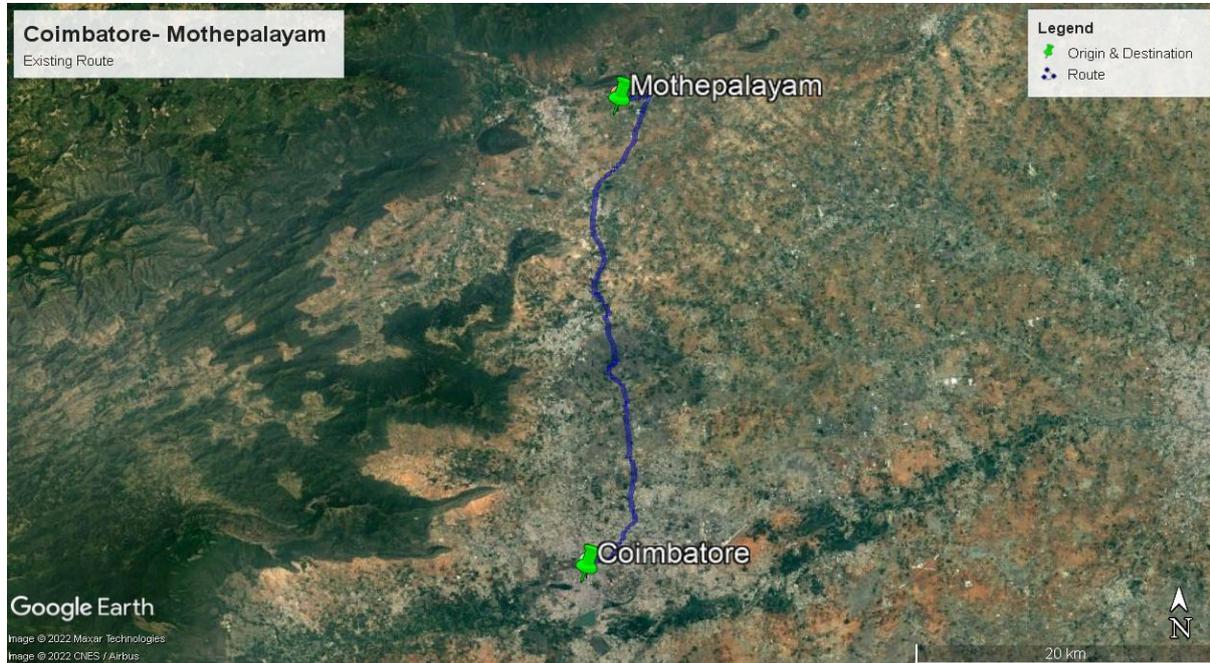

Figure 19: Route Map of existing Coimbatore-Mothepalayam Route

The key findings from the comparative analysis (Figure 20) are:

- In scenario 1, only >10.5m & 8.5-10.5m (OEM 2) models are profitable
- In scenario 2, 3, 4, 5 & 6 only >10.5m, 8.5-10.5m (OEM 1) & 8.5-10.5m (OEM 2) models are profitable
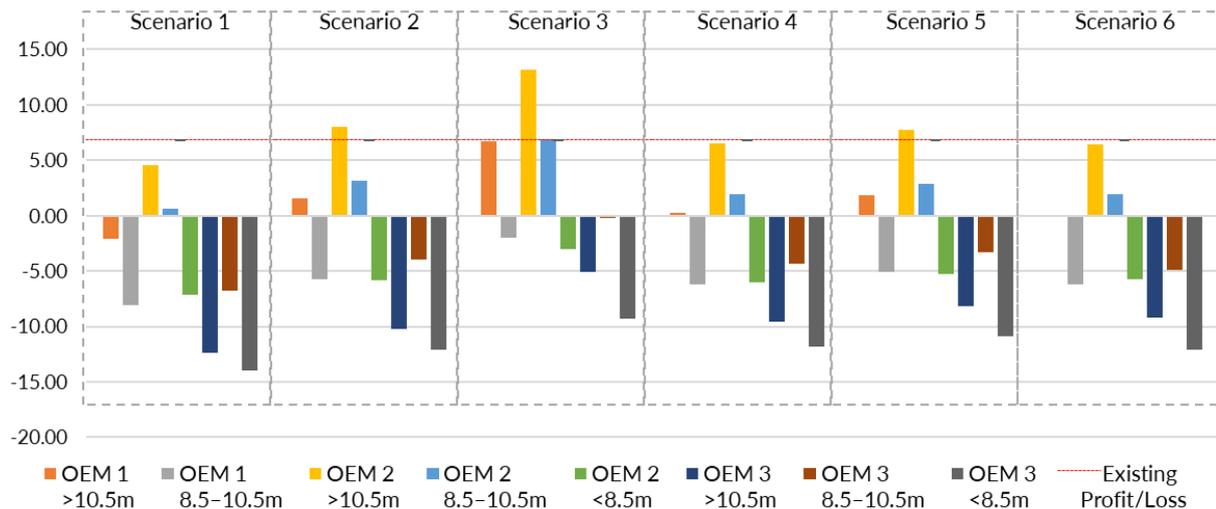
Figure 20: Annual Profitability / Loss on each e-bus model for Coimbatore Mothepalayam route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, only

>10.5m length (from OEM 1&2) and 10.5m-8.5m length (from OEM 2) models present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that all bus models remain unprofitable over this period. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

Whereas in scenario 6a, except two models, i.e., >10.5m length and 8.5-10.5m length from OEM 2, all other bus models remain in loss for the first six years (i.e., during the loan tenure) while all other models are profitable. Table 23 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a

Table 23: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	0.09	-6.18	6.39	1.89	-5.75	-9.22	-4.93	-12.15
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-16.43	-16.58	-7.02	-6.98	-11.48	-25.52	-26.11	-27.76
	Avg Profit / Loss in last 8 years	15.72	6.40	19.49	11.14	3.58	12.29	10.12	1.38
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-3.26	-8.66	3.91	0.61	-6.46	-12.93	-12.55	-17.34
	Avg Profit / Loss in last 6 years	13.26	6.14	17.39	9.58	3.58	12.29	8.63	0.67

3.2.2.6 Lease Model for all Routes in Scenario 1

Based on discussion with various private operators, it is understood that operators are keen for alternate modes of ownership to cushion off the impact of initial capital investment. They look forward to a mix of wet and dry lease model where the lessor provides the bus, complete annual maintenance (including, servicing, maintenance, spares, tyres, battery replacement, etc.) and insurance, while the lessee provides the staff, pays for the energy, and pays any taxes/permit fees etc. Table 24 presents the expected maximum, lease cost per km for each of the routes in Tamil Nadu, with a promised minimum average km of operations. It is estimated that at this price the operator will be able to make an average profit of ₹ 4.50 per km throughout the service life of the bus.

Table 24: Tamil Nadu: Maximum Cost for Lease Models of E-Buses

Routes	Min. assured km per annum for each bus (In KM)	OEM 1 - E-bus (Lease cost in ₹ / km)		OEM 2 - E-bus (Lease cost in ₹ / km)			OEM 3 - E-bus (Lease cost in ₹ / km)		
		>10.5 m	8.5-10.5m	>10.5 m	8.5-10.5m	<8.5 m	12m	8.5 m	<8.5m
Tiruchi – Pudukkottai	1,38,700	22.22	12.71	25.01	14.87	7.82	23.93	13.52	5.84
Tiruchi – Ariyalur	1,38,700	22.22	12.71	25.01	14.87	7.82	23.93	13.52	5.84
Tiruchi-Thurailur	1,38,700	22.22	12.71	25.01	14.87	7.82	23.93	13.52	5.84
Coimbatore Pollachi	1,24,830	21.47	11.96	24.26	14.12	7.06	23.18	12.77	5.08
Coimbatore - Mothepalayam	1,24,830	21.47	11.96	24.26	14.12	7.06	23.18	12.77	5.08

3.2.3 Dewas, Madhya Pradesh (MP)

Route details of five routes for which business model has been developed in MP has been presented in Table 25.

Table 25: Route details of Tamil Nadu

S. No.	Origin	Destination	Route Length (Km)
1	Dewas	Ujjain	37
2	Dewas	Indore	40
3	Indore	Shujalpur	180
4	Indore	Biaora	193
5	Dewas	Neemuch	246

The per km profit or loss in ownership model for each e-bus model in Scenario 1, for each route of MP have been generated as average per km profit overall, i.e., average over 12 years' service life of bus, average during the first four years (during the loan tenure) and average during the following eight years (after the loan tenure). The same has been presented in Table 26. The details of business plans for each of these routes for all six scenarios has been presented in subsequent sub sections.

Route Names	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m E-bus	<8.5m E-bus
Route 1: Dewas – Ujjain	Overall Profit / Loss	-0.56	- 12.02	7.73	0.22	-0.32	-6.66	-7.59	-17.37
	Avg Profit / Loss in first 4 years (₹/km)	-17.11	-22.86	-6.39	-8.81	-10.85	-26.59	-31.48	-34.01
	Avg Profit / Loss in last 8 years	18.99	5.69	23.92	11.70	8.23	17.71	10.83	0.68
Route 2: Dewas – Indore	Overall Profit / Loss	-1.31	-12.49	5.58	-3.40	-13.87	-7.13	-19.24	-15.95
	Avg Profit / Loss in first 4 years (₹/km)	-24.08	-26.46	-12.95	-14.88	-20.44	-31.51	-38.54	-38.79
	Avg Profit / Loss in last 8 years (₹/km)	17.66	3.2	21.44	8.25	-0.62	16.23	2.28	0.89
Route 3: Indore – Dewas - Shujalpur	Overall Profit / Loss	-5.08	-12.10	2.39	-3.60	-8.56	-4.49	-12.47	-17.48
	Avg Profit / Loss in first 4 years (₹/km)	-28.17	-28.13	-17.23	-16.80	-16.95	-37.65	-40.07	-38.89
	Avg Profit / Loss in last 8 years (₹/km)	13.48	2.59	17.75	7.21	0.84	22.21	10.08	-1.36
Route 4: Indore – Dewas - Biaora	Overall Profit / Loss	-3.76	-11.47	3.71	-2.36	-8.42	-2.21	-10.53	-16.58
	Avg Profit / Loss in first 4 years (₹/km)	-23.54	-24.28	-13.60	-13.57	-15.49	-32.27	-35.35	-34.86
	Avg Profit / Loss in last 8 years (₹/km)	13.99	2.76	17.94	8..01	1.46	23.56	6.65	-1.12
Route 5: Dewas– Neemuch	Overall Profit / Loss	-6.16	-18.33	2.15	-3.14	-16.93	1.40	-8.26	-20.74
	Avg Profit / Loss in first 4 years (₹/km)	-14.58	-22.02	-5.62	-7.81	-16.03	-17.27	-22.34	-29.98
	Avg Profit / Loss in last 8 years (₹/km)	12.38	0.58	17.72	8.16	-1.74	18.63	6.56	-2.77

3.2.3.1   Ownership Model for Route 1: Dewas – Ujjain

The route length of Dewas to Ujjain route is 37 km (refer Figure 21). The average (over the service life of the bus) EPK for this route is ₹ 45/km and the existing profit is ₹ 5.45/Km.
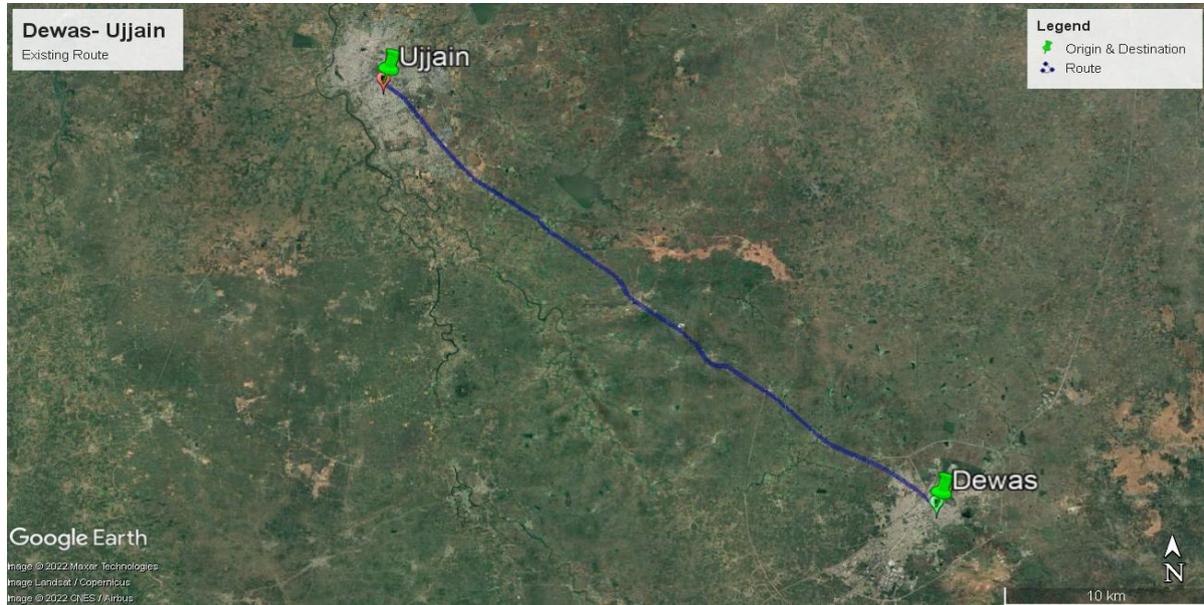
Figure 21: Route Map of existing Dewas-Ujjain Route

The key findings from the comparative analysis (Figure 22) are:

- In scenario 1 & 4, >10.5m (OEM 3) & OEM 2 all models are profitable
- In scenario 3, all e-bus models are profitable except 8.5-10.5m (OEM 1) and <8.5m (OEM 3)
- In scenario 2, 4, 5 & 6 all e-bus models are profitable except 8.5-10.5m (OEM 1) and OEM 3 all models
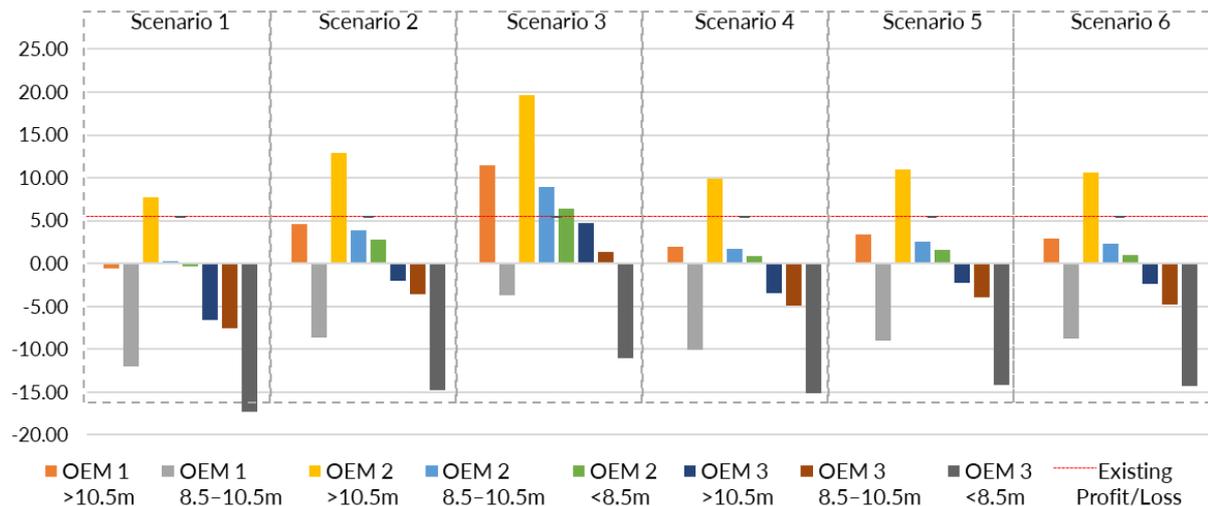
Figure 22: Annual Profitability / Loss on each e-bus model for Dewas – Ujjain route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, all models except four bus models i.e., 8.5m-10.5m (OEM 1& OEM 3), >10.5M & <8.5M length model for

OEM 3 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that all bus models remain unprofitable over this period. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

Whereas, in scenario 6a, five models, i.e., >10.5m from OEM 2&3 <8.5m length from OEM 2&3 and 8.5-10.5m length from OEM 1 & 3 remain in loss for the first six years (i.e., during the loan tenure) while all other models are profitable. Table 27 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a

Table 27: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1 >10.5m E-bus	8.5-10.5m	OEM 2 >10.5m E-bus	8.5-10.5m	<8.5m E-bus	OEM 3 >10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	2.89	-8.82	10.57	2.29	1.00	-2.33	-4.80	-14.35
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-11.80	-18.45	-1.97	-5.73	-8.34	-20.02	-26.01	-29.12
	Avg Profit / Loss in last 8 years	20.24	6.91	24.94	12.48	8.59	19.31	11.56	1.67
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	0.68	-10.01	7.87	0.91	-1.73	-6.93	-11.58	-18.87
	Avg Profit / Loss in last 6 years	18.43	6.90	24.05	11.90	7.62	19.30	9.63	1.67

3.2.3.2 Ownership Model for Route 2: Dewas – Indore

The route length of Dewas to Indore route is 40 km (refer Figure 23). The average (over the service life of the bus) EPK for this route is ₹ 50/km and the existing profit is ₹ 4.80/Km.
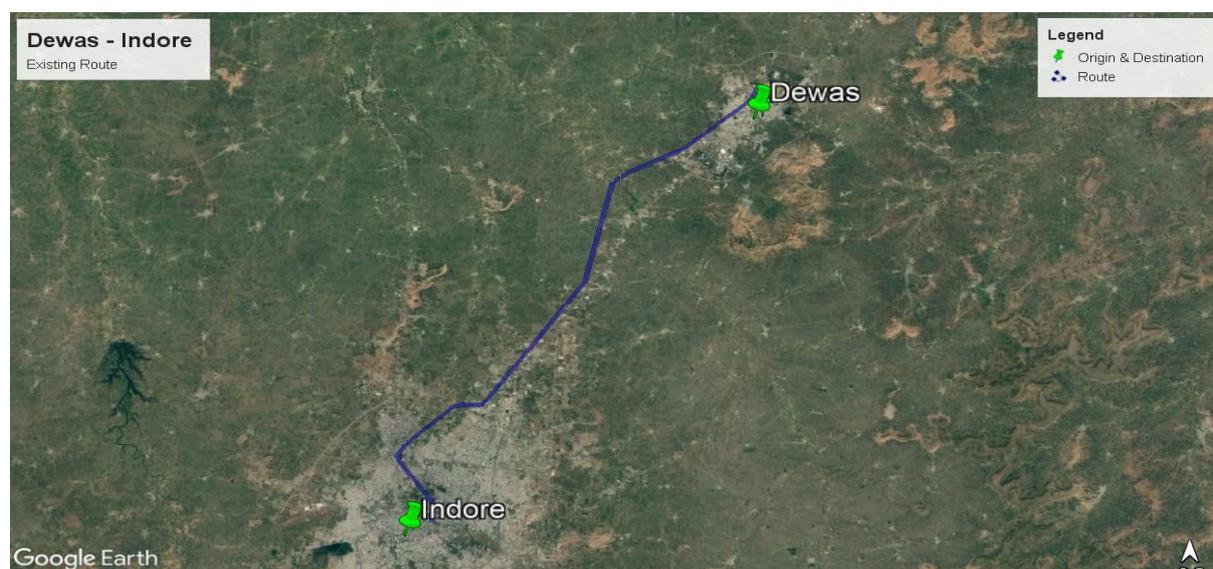

Figure 23: Route Map of existing Dewas-Indore Route

The key findings from the comparative analysis (Figure 24) are:

- In scenario 1, only >10.5m (OEM 2) e-bus is profitable
- In scenario 2, only >10.5m (OEM 1 & OEM 2) and 8.5-10.5m (OEM 2) are profitable
- In scenario 3, >10.5m (OEM 1,2 & 3) and 8.5-10.5m (OEM 2) e-bus models are profitable
- In scenario 4, 5 & 6, only >10.5m (OEM 1 & OEM 2) e-bus models are profitable
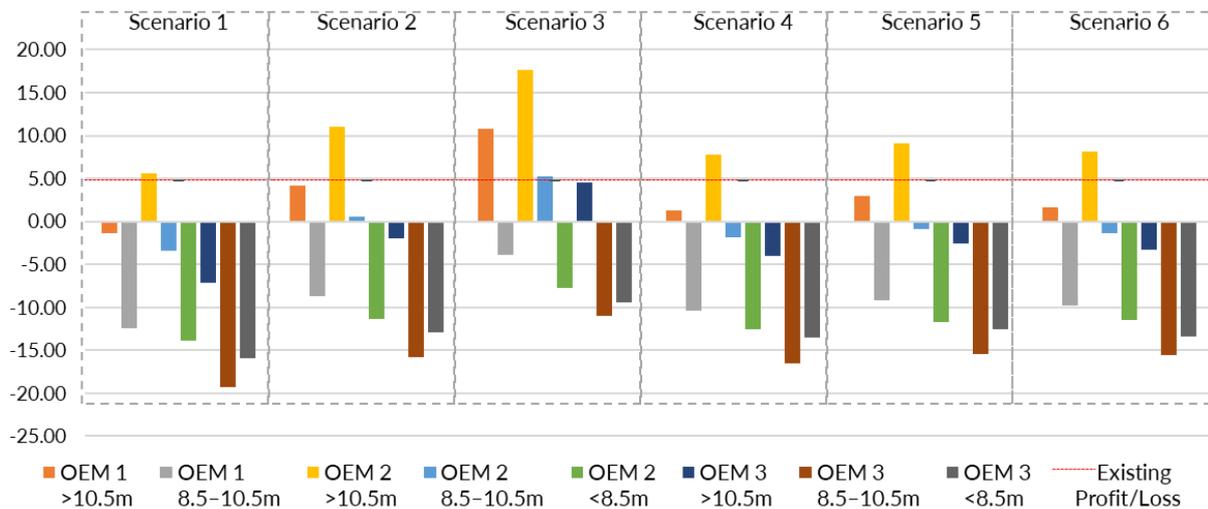
Figure 24: Annual Profitability / Loss on each e-bus model for Dewas – Indore route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, only two bus models i.e., **>10.5m E-bus** length model for OEM 1 & 2 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that none of the bus models present average profit during the loan tenure. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

Whereas, in scenario 6a, except only one model, i.e., >10.5m length from OEM 2, all other bus model remains in loss for the first six years (i.e., during the loan tenure) while all other models are profitable except <8.5m length from OEM 3 bus model. Table 28 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a

Table 28: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1 >10.5m E-bus	8.5-10.5m	OEM 2 >10.5m E-bus	8.5-10.5m	<8.5m E-bus	OEM 3 >10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	1.67	-9.75	8.10	-1.43	-11.49	-3.26	-15.58	-13.45
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-18.55	-22.16	-8.35	-11.62	-17.32	-24.90	-32.72	-33.74
	Avg Profit / Loss in last 8 years	18.51	4.18	22.19	8.91	0.28	17.48	3.53	1.49

Scenario 6	Parameters	OEM 1 >10.5m E-bus	8.5-10.5m	OEM 2 >10.5m E-bus	8.5-10.5m	<8.5m E-bus	OEM 3 >10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-3.96	-13.03	3.77	-3.30	-11.47	-8.76	-20.65	-20.41
	Avg Profit / Loss in last 6 years	16.26	3.81	20.23	7.42	0.27	15.45	3.52	-0.11

3.2.3.3 Ownership Model for Route 3: Indore – Dewas – Shujalpur

The route length of Indore –Dewas – Shujalpur route is 180 km (refer Figure 25). The average (over the service life of the bus) EPK for this route is ₹ 44/km and the existing profit is ₹ 3.83/Km.
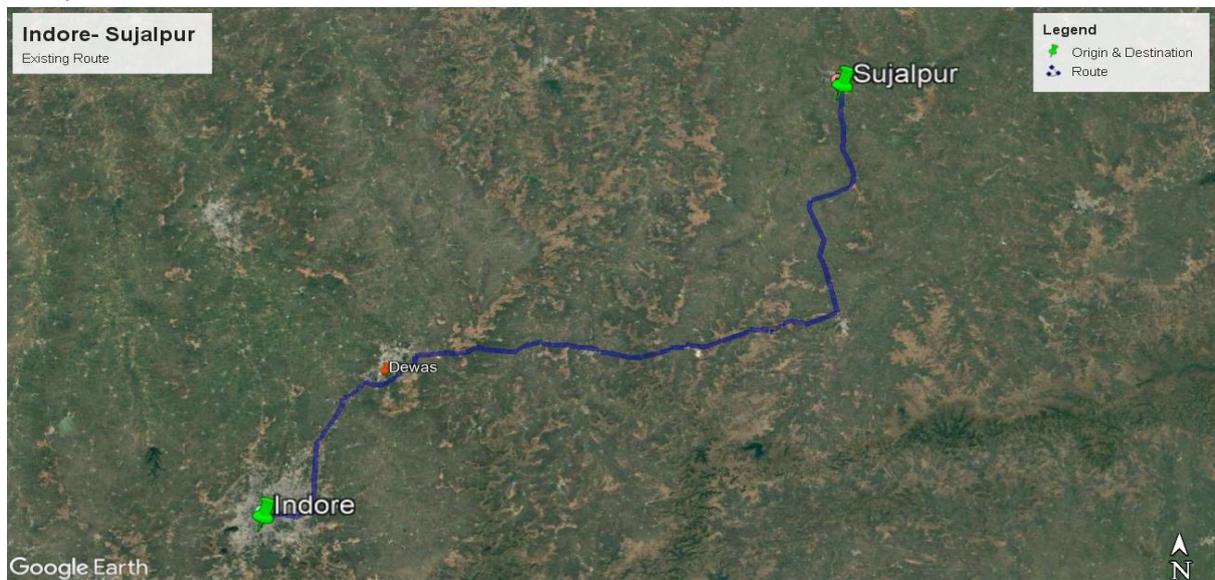

Figure 25: Route Map of existing Indore-Dewas-Shujalpur Route

The key findings from the comparative analysis (Figure 26) are:

- In scenario 1, 2, 4, 5 & 6, only >10.5m (OEM 2) e-bus is profitable rest of all are in loss
- In scenario 2, >10.5m (OEM 1,2 & 3) and 8.5-10.5m (OEM 2) e-bus models are profitable
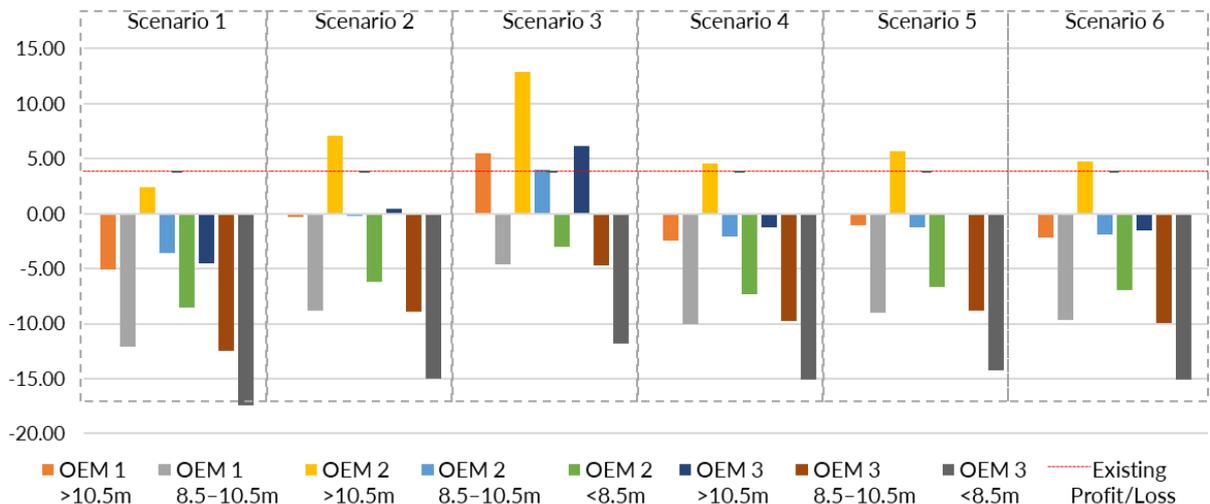

Figure 26: Annual Profitability / Loss on each e-bus model for Indore –Dewas – Shujalpur route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, only one bus model i.e., >10.5m from OEM 2 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that all bus models remain unprofitable over this period. However, after the loan tenure all buses except <8.5 m length (from OEM3) shows average profits over the rest of the service life of the bus.

Whereas, in scenario 6a, all bus models remain in loss for the first six years (i.e., during the loan tenure) while all other models except <8.5m length from OEM 3 are profitable. Table 29 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a.

Table 29: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1 >10.5m E-bus	8.5-10.5m	OEM 2 >10.5m E-bus	8.5-10.5m	<8.5m E-bus	OEM 3 >10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	-2.21	-9.70	4.73	-1.91	-6.93	-1.50	-9.94	-15.07
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-22.72	-23.94	-12.69	-13.64	-14.37	-30.94	-34.44	-34.08
	Avg Profit / Loss in last 8 years	14.27	3.34	18.37	7.69	1.42	22.21	10.08	-0.75
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-8.32	-12.88	-0.71	-5.29	-8.93	-13.24	-19.62	-21.38
	Avg Profit / Loss in last 6 years	12.19	1.36	16.72	6.44	1.23	22.21	10.08	-2.36

3.2.3.4 Ownership Model for Route 4: Indore – Dewas –Biaora

The route length of Indore –Dewas –Biaora route is 193 km (refer Figure 27). The average (over the service life of the bus) EPK for this route is ₹ 44/km and the existing profit is ₹ 3.67/Km.
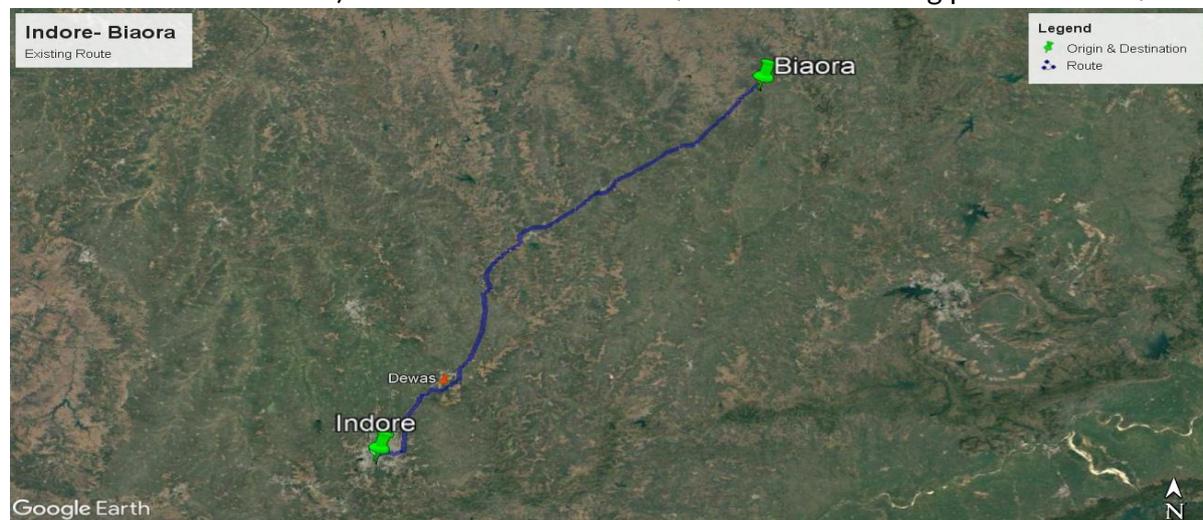

Figure 27: Route Map of existing Indore-Dewas-Biaora Route

The key findings from the comparative analysis (Figure 28) are:

- In scenario 1, 2, 4, 5 & 6, none of the e-bus models are profitable
- In scenario 3, only >10.5m (OEM 2) e-bus model is profitable
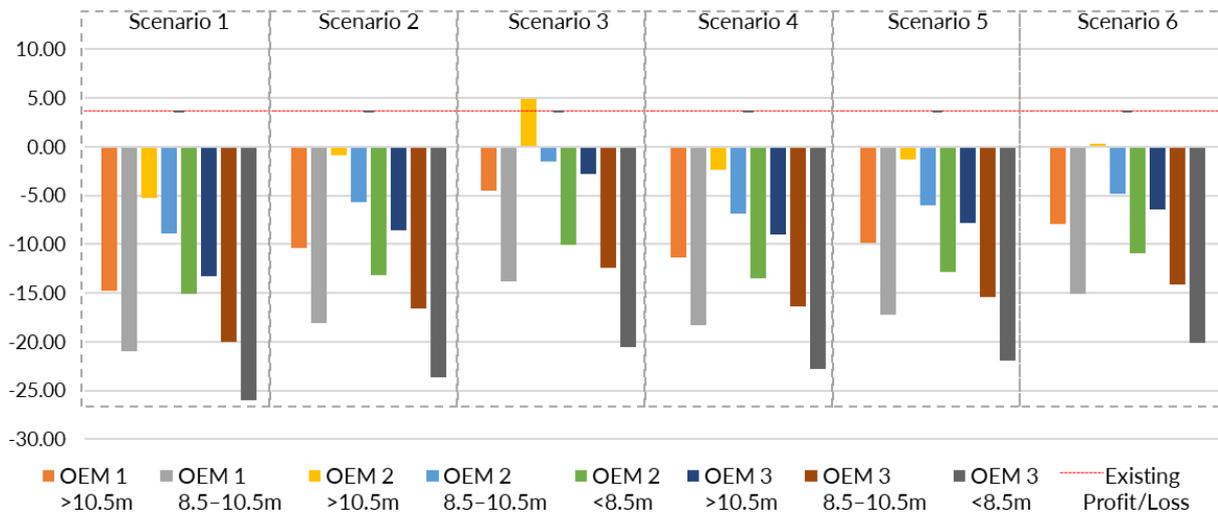
Figure 28: Annual Profitability / Loss on each e-bus model for Indore –Dewas – Biaora route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, only 2 bus models >10.5m length model for OEM 2 & OEM 3 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that all bus models remain unprofitable over this period. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

Whereas, in scenario 6a, all bus models except >10.5m length for OEM 2 remain in loss for the first six years (i.e., during the loan tenure) while all other models are profitable except <8.5 length for OEM 3. Table 30 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a

Table 30: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	-0.89	-9.00	6.06	-0.66	-6.67	0.68	-8.07	-14.13
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-18.45	-20.36	-8.92	-10.61	-12.95	-26.01	-30.11	-30.37
	Avg Profit / Loss in last 8 years	14.87	3.64	19.09	8.54	2.10	23.56	7.18	-0.41
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-5.03	-11.70	2.26	-2.83	-7.94	-9.50	-16.28	-19.46

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
	Avg Profit / Loss in last 6 years	12.54	2.96	17.24	7.13	2.09	23.56	5.77	-1.35

3.2.3.5   Ownership Model for Route 5: Dewas – Neemuch

The route length of Dewas to Neemuch route is 246 km (refer Figure 29). The average (over the service life of the bus) EPK for this route is ₹ 44/km and the existing profit is ₹ 5.33/Km.
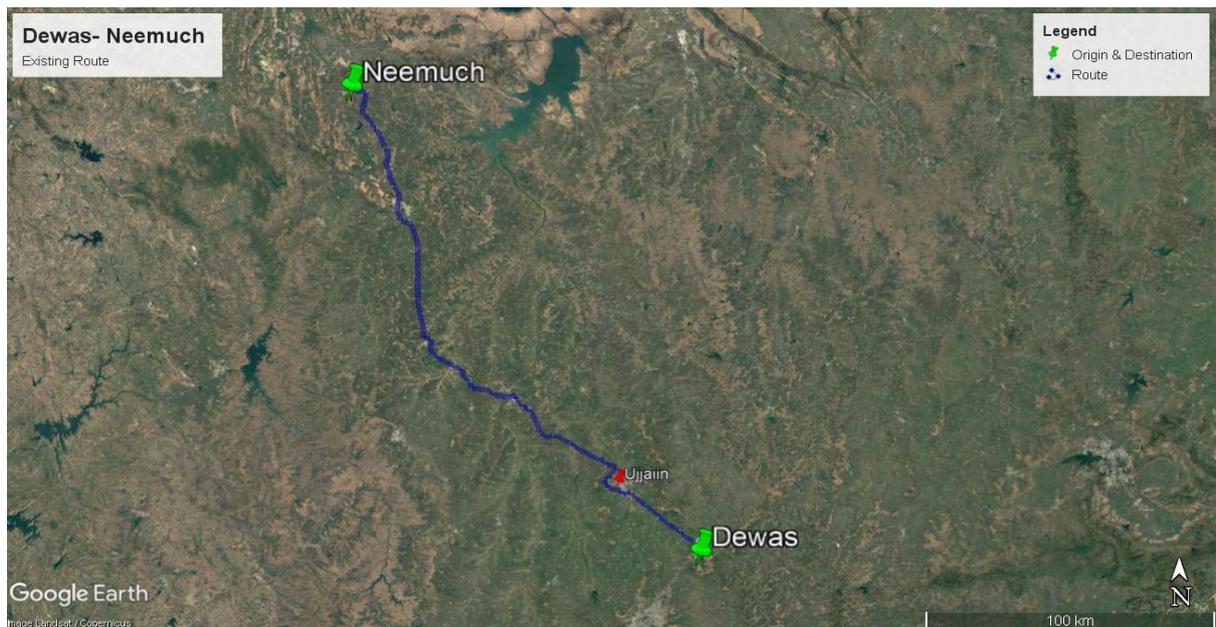

Figure 29: Route Map of existing Indore-Dewas-Neemuch Route

The key findings from the comparative analysis (Figure 30) are:

- In scenario 1, 2, 4, 5 & 6, only >10.5m (OEM 2 & OEM 3) e-bus models are profitable
- In scenario 3, >10.5m (OEM1, OEM 2 & OEM 3) and 8.5-10.5m (OEM 2) e-bus models are profitable
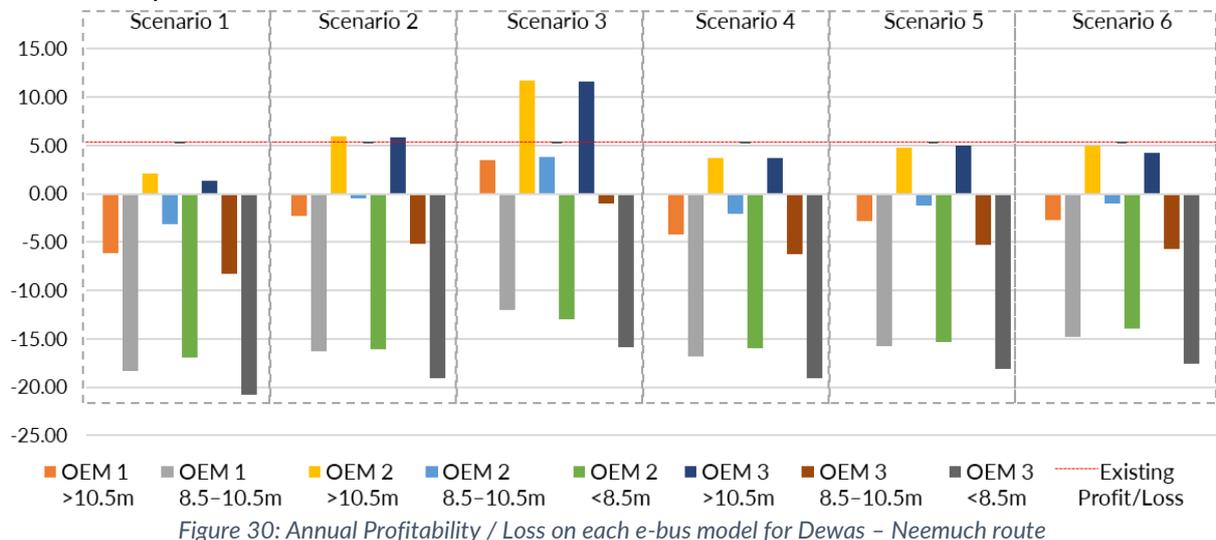
Figure 30: Annual Profitability / Loss on each e-bus model for Dewas – Neemuch route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, only 2 bus models i.e., >10.5m length model for OEM 2 & 3 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that all bus models remain unprofitable over this period. However, after the loan tenure all bus models except <8.5m length (OEM 2 & 3) show average profits over the rest of the service life of the bus.

Whereas, in scenario 6a, except two bus models, i.e., >10.5m length from OEM 2 & 3, all other bus models remain in loss for the first six years (i.e., during the loan tenure) while all other models except <8.5 length for OEM 3 are profitable. Table 31 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a

Table 31: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	-2.69	-14.75	5.00	-1.02	-13.96	4.22	-5.72	-17.57
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-10.16	-18.03	-1.90	-5.17	-13.17	-12.36	-18.23	-25.77
	Avg Profit / Loss in last 8 years	13.78	2.03	18.83	9.01	-0.49	19.52	7.44	-1.62
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-2.19	-11.36	5.00	-0.45	-8.95	0.29	-9.62	-17.73
	Avg Profit / Loss in last 6 years	13.77	2.03	18.83	9.00	-0.49	17.48	7.37	-1.62

3.2.3.6   Lease Model for all Routes in Scenario 1

Based on discussion with various private operators, it is understood that operators are keen for alternate modes of ownership to cushion off the impact of initial capital investment. They look forward to a mix of wet and dry lease model where the lessor provides the bus, complete annual maintenance (including, servicing, maintenance, spares, tyres, battery replacement, etc.) and insurance, while the lessee provides the staff, pays for the energy, and pays any taxes/permit fees etc.

Table 32 presents the expected maximum, lease cost per km for each of the routes in MP, with a promised minimum average km of operations. It is estimated that at this price the operator will be able to make an average profit of ₹ 4.50 per km throughout the service life of the bus.

Table 32: Dewas Madhya Pradesh: Maximum Cost for Lease Models of E-Buses

Routes	Min. assured km per annum for each bus (In KM)	OEM 1 - E-bus (Lease cost in ₹ / km)			OEM 2 - E-bus (Lease cost in ₹ / km)			OEM 3 - E-bus (Lease cost in ₹ / km)		
		>10.5m	8.5-10.5m	>10.5m	8.5-10.5m	<8.5m	12m	8.5m	<8.5m
Dewas - Ujjain	1,28,298	31.23	17.28	34.02	19.44	9.42	32.94	18.09	7.44
Dewas - Indore	1,28,298	26.23	12.69	29.02	14.94	5.24	28.38	14.18	4.20
Indore – Dewas - Shujalpur	1,24,830	21.63	10.19	24.42	12.35	4.01	23.34	11.00	2.03
Indore – Dewas - Biaora	1,33,846	22.60	11.17	25.39	13.33	4.98	24.31	11.98	3.00
Dewas - Neemuch	1,70,601	24.44	13.01	27.23	15.17	6.82	26.15	13.82	4.84

3.2.4 Uttar Pradesh

Route details of five routes for which business model has been developed in Uttar Pradesh has been presented in Table 33.

Table 33: Route details of UT of Ladakh

S. No.	Origin	Destination	Route Length (Km)
1	Charbagh	Ayodhya	138
2	Alambagh	Prayagraj Via Raibareli	208
3	Kaisarbagh	Bahraich	130
4	Charbagh	Kanpur	96
5	Charbagh	Barabanki	41

The per km profit or loss in ownership model for each e-bus model in Scenario 1, for each route of Uttar Pradesh have been generated as average per km profit overall, i.e., average over 12 years' service life of bus, average during the first four years (during the loan tenure) and average during the following eight years (after the loan tenure). The same has been presented in Table 34. The details of business plans for each of these routes for all six scenarios has been presented in subsequent sub sections

Route Names	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m E-bus	<8.5m E-bus
Route 1: Charbagh-Ayodhya	**Overall Profit / Loss**	**-39.26**	**-21.34**	**-27.07**	**-23.05**	**-14.69**	**-32.13**	**-33.14**	**-26.38**
	Avg Profit / Loss in first 4 years (₹/km)	-57.45	-47.28	-44.03	-33.17	-29.96	-70.34	-63.10	-57.98
	Avg Profit / Loss in last 8 years	-11.22	1.50	-4.03	-6.32	0.02	-1.79	-7.08	-1.96
Route 2: Alambagh-Prayagraj VIA Raibareli	**Overall Profit / Loss**	**-1.08**	**-17.23**	**6.48**	**-2.35**	**-28.44**	**5.12**	**-5.35**	**-16.86**
	Avg Profit / Loss in first 4 years (₹/km)	-17.15	-26.07	-6.24	-9.64	-24.99	-24.87	-29.7	-35.43
	Avg Profit / Loss in last 8 years (₹/km)	20.98	6.47	25.44	13.5	-3.9	28.63	15.2	3.7
Route 3: Kaisarbagh-Bahraich VIA Masuli	**Overall Profit / Loss**	**-11.81**	**-14.64**	**-5.23**	**-7.63**	**-12.30**	**-21.24**	**-27.44**	**-18.20**
	Avg Profit / Loss in first 4 years (₹/km)	-34.45	-30.7	-24.07	-19.97	-19.92	-41	-43.43	-40.36
	Avg Profit / Loss in last 8 years (₹/km)	10.41	-0.64	13.2	3.06	-2.84	1.17	-5.5	-2.68
Route 4: Charbagh-Kanpur	**Overall Profit / Loss**	**-6.44**	**-10.68**	**0.88**	**-2.15**	**-8.03**	**-5.15**	**-10.16**	**-16.26**
	Avg Profit / Loss in first 4 years (₹/km)	-25.04	-22.8	-15.04	-12.53	-14.19	-33.23	-33.26	-33.32

Route Names	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m E-bus	<8.5m E-bus
	Avg Profit / Loss in last 8 years (₹/km)	11.01	3.41	15.4	8.31	1.55	19.73	6.81	-0.96
Route 5: Charbagh-Barabanki	**Overall Profit / Loss**	-17.15	-10.36	-7.13	-9.14	-7.70	-11.79	-18.20	-18.34
	Avg Profit / Loss in first 4 years (₹/km)	-35.2	-31.67	-22.67	-18.55	-19.53	-46.88	-46.1	-45.38
	Avg Profit / Loss in last 8 years (₹/km)	8.22	7.45	13.99	6.16	3.86	16.01	5.58	1.36

3.2.4.1 Ownership Model for Route 1: Charbagh – Ayodhya

The route length of Charbagh to Ayodhya route is 138 km (refer Figure 31). The average (over the service life of the bus) EPK for this route is ₹ 26/km and the existing loss is ₹ -8.95/Km.
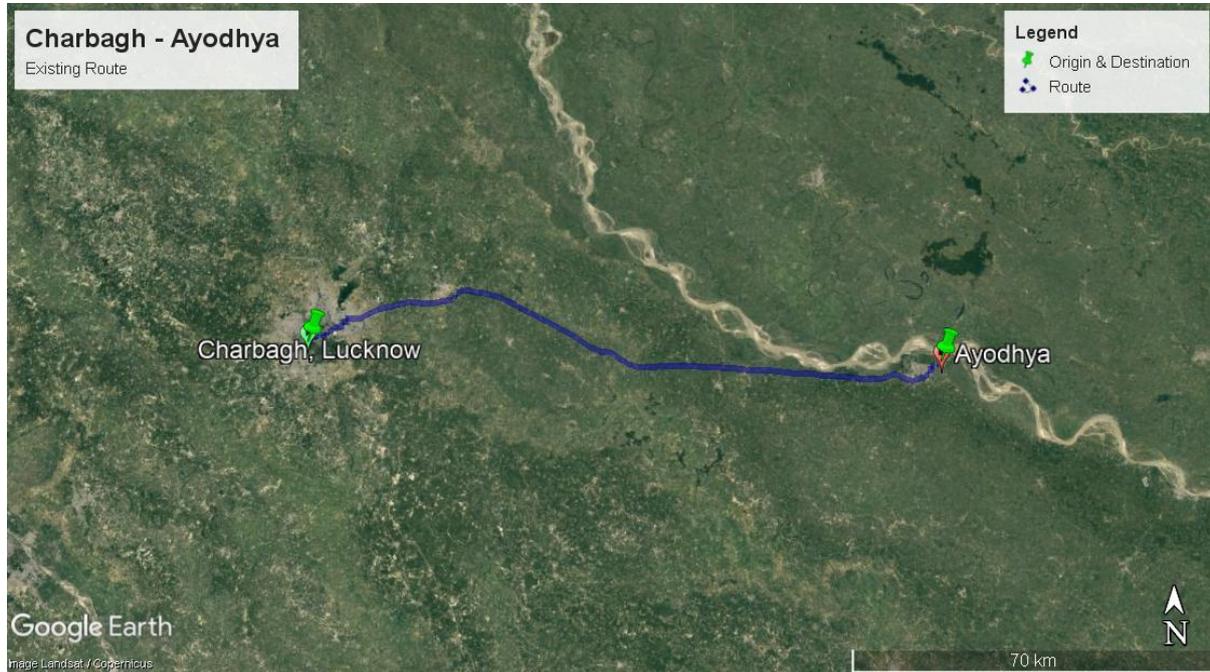
Figure 31: Route Map of existing Charbagh-Ayodhya Route

The key findings from the comparative analysis (Figure 32) are:

- In all scenarios none of the e-bus models are profitable
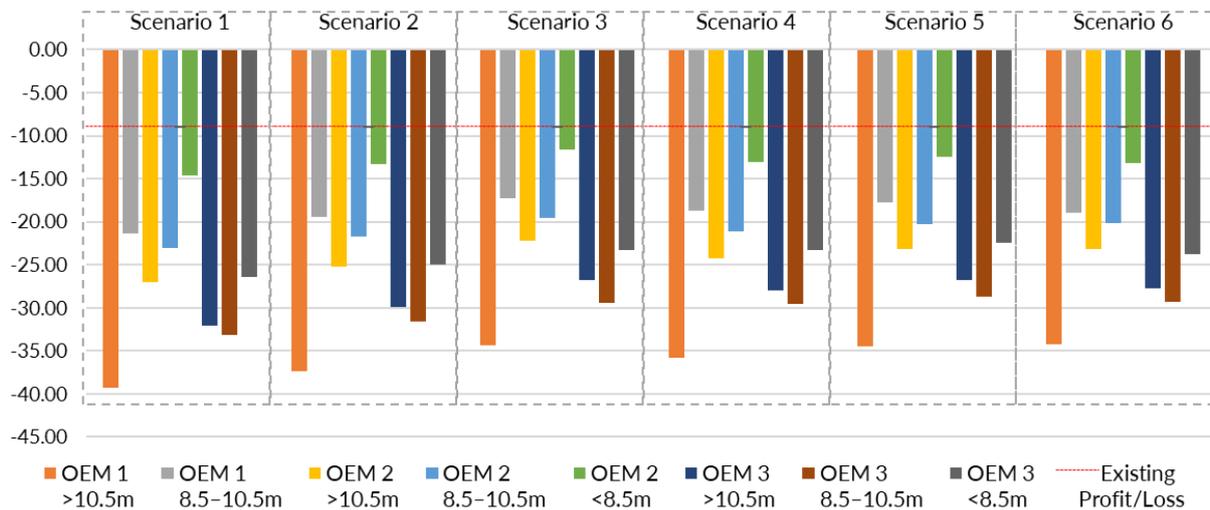
Figure 32: Annual Profitability / Loss on each e-bus model for Charbagh – Ayodhya route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, none of the models are profitable over the entire service life of the bus (12 years). When a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that all models still remain unprofitable over this period. However,

after the loan tenure two bus models i.e., 8.5m-10.5m length (OEM 1) & <8.5M length (OEM 2) shows average profits over the rest of the service life of the bus.

In scenario 6a as well, all models remain in loss for the first six years (i.e., during the loan tenure) while two buses i.e., 8.5m-10.5m length bus model from OEM 1 & <8.5M length bus model from OEM 2 shows marginal profitability. Table 35 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a.

Table 35: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	-34.31	-18.91	-23.17	-20.18	-13.16	-27.79	-29.29	-23.77
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-76.85	-62.18	-60.18	-44.42	-39.12	-94.19	-83.08	-75.10
	Avg Profit / Loss in last 8 years	-16.49	1.50	-7.96	-9.37	0.02	-4.71	-9.95	-1.96
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-261.78	-183.40	-211.07	-152.52	-113.62	-288.23	-245.59	-214.30
	Avg Profit / Loss in last 6 years	-97.58	1.50	-69.11	-55.37	0.02	-64.58	-68.85	-1.96

3.2.4.2   Ownership Model for Route 2: Alambagh - Prayagraj VIA Raibareli

The route length of Alambagh to Prayagraj route is 208 km (refer Figure 33). The average (over the service life of the bus) EPK for this route is ₹ 42/km and the existing loss is ₹ -1.19/Km.
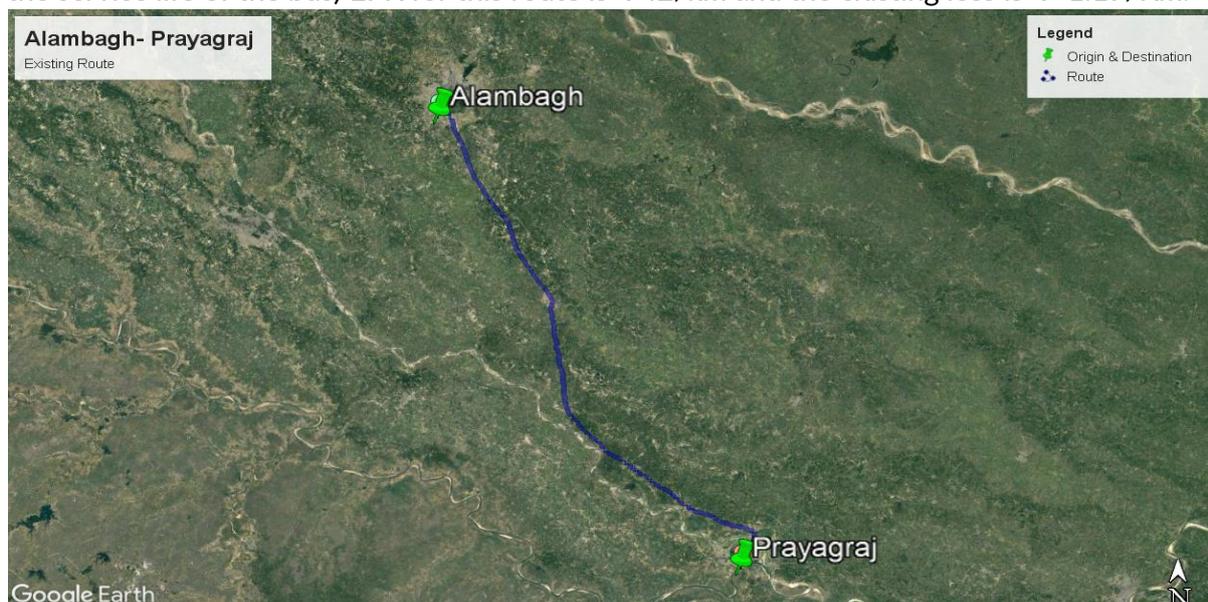

Figure 33: Route Map of existing Alambagh-Prayagraj Route

The key findings from the comparative analysis (Figure 34) are:

- In scenario 1, only >10.5m (OEM 2 & OEM 3) models are profitable
- In scenario 2, >10.5m (OEM 1, OEM 2 & OEM 3) and 8.5-10.5m (OEM 2) e-bus models are profitable
- In scenario 3, all e-bus models are profitable except 8.5-10.5m (OEM 1) and <8.5m (OEM 2 & OEM 3) e-bus models
- In scenario 4, 5 & 6 only >10.5m (OEM 1, OEM 2 & OEM 3) e-bus models are profitable
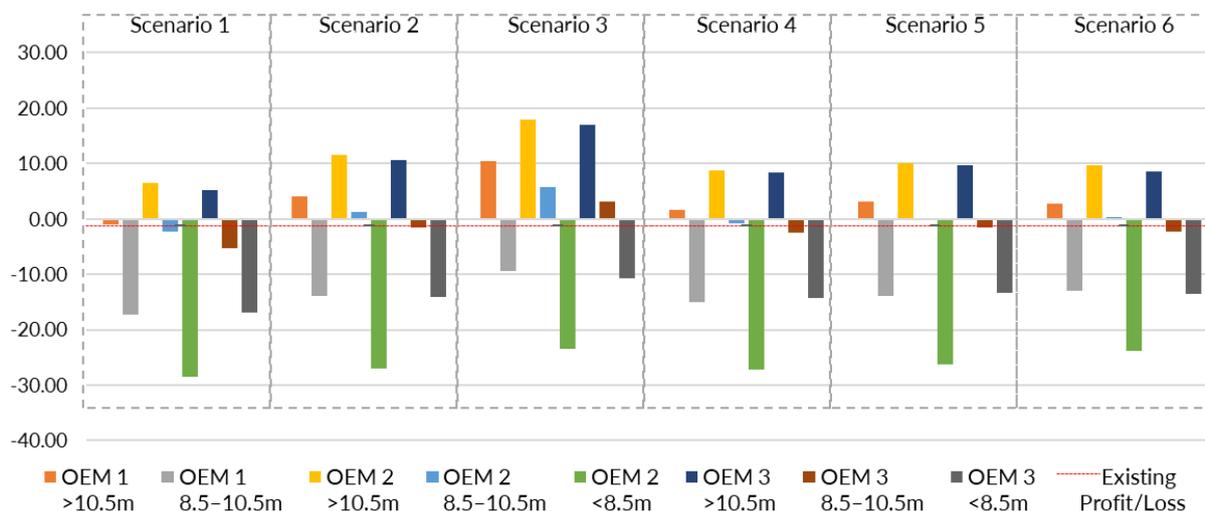
Figure 34: Annual Profitability / Loss on each e-bus model for Alambagh to Prayagraj route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, none of the models are profitable over the entire service life of the bus (12 years). When a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that all models still remain unprofitable over this period. However, after the loan tenure two bus models i.e., 8.5m-10.5m length (OEM 1) & <8.5M length (OEM 2) shows average profits over the rest of the service life of the bus.

In scenario 6a as well, all models remain in loss for the first six years (i.e., during the loan tenure) while two buses i.e., 8.5m-10.5m length bus model from OEM 1 & <8.5M length bus model from OEM 2 shows marginal profitability. Table 36 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a.

Table 36: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	-34.31	-18.91	-23.17	-20.18	-13.16	-27.79	-29.29	-23.77
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-76.85	-62.18	-60.18	-44.42	-39.12	-94.19	-83.08	-75.10

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
	Avg Profit / Loss in last 8 years	-16.49	1.50	-7.96	-9.37	0.02	-4.71	-9.95	-1.96
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-261.78	-183.40	-211.07	-152.52	-113.62	-288.23	-245.59	-214.30
	Avg Profit / Loss in last 6 years	-97.58	1.50	-69.11	-55.37	0.02	-64.58	-68.85	-1.96

3.2.4.3 Ownership Model for Route 3: Qaisarbagh - Bahraich VIA Masuli

The route length of Qaisarbagh to Bahraich route is 134 km (refer Figure 35). The average (over the service life of the bus) EPK for this route is ₹ 31/km and the existing loss is ₹ -9.43/Km.
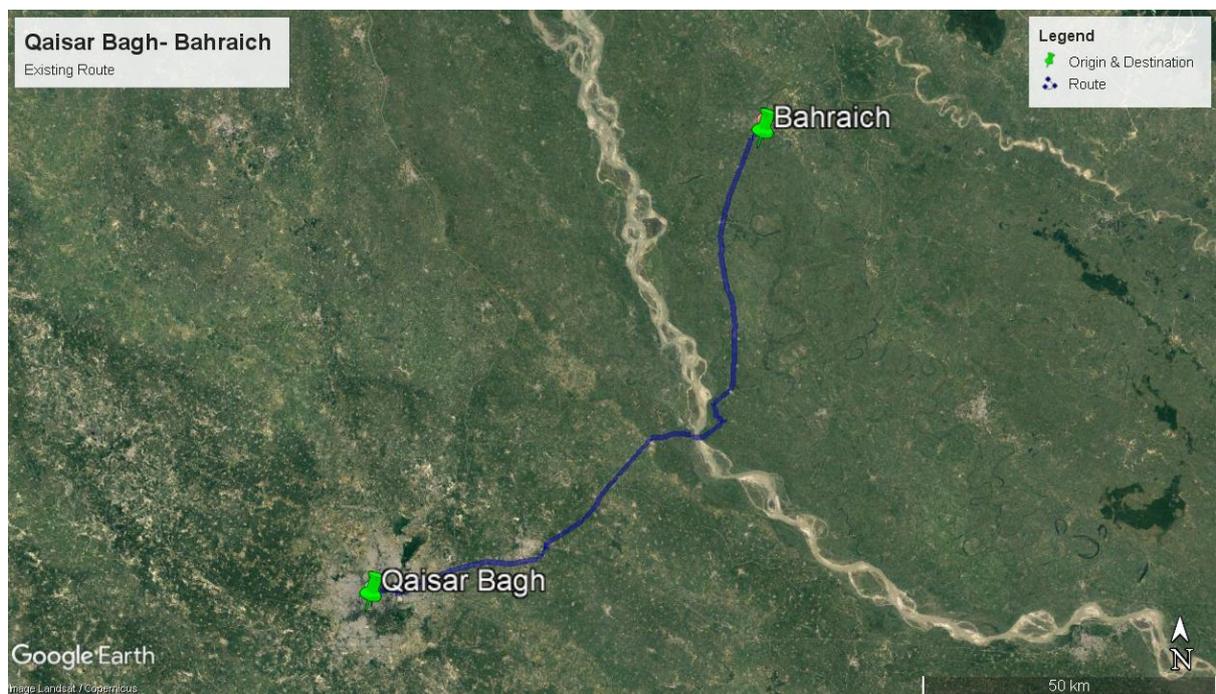

Figure 35: Route Map of existing Qaisarbagh-Bahraich Route

The key findings from the comparative analysis (Figure 36) are:

- In scenario 1, 2, 4, 5 & 6 none of the e-bus models are profitable
- In scenario 3, >10.5m (OEM 2) e-bus model is profitable
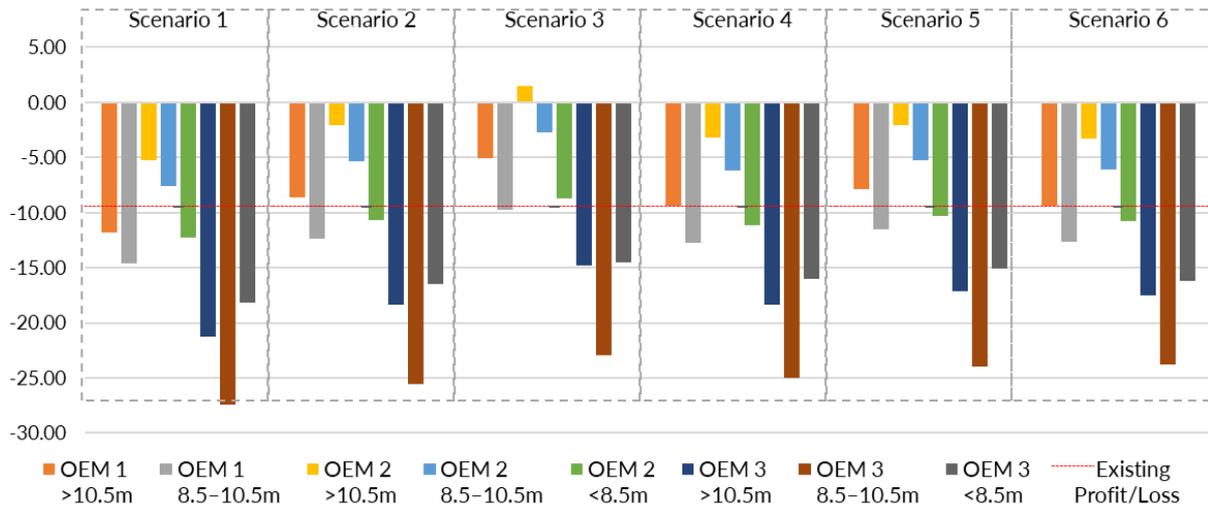
Figure 36: Annual Profitability / Loss on each e-bus model for Kaisarbagh to Bahraich route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, none of the models present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that average profit during the loan tenure also remain unprofitable over this period. However, after the loan tenure three bus models show average profits i.e., >10.5m length E-bus models from OEM 1, 2 & 3 and 8.5-10.5m length bus model from OEM 2 over the rest of the service life of the bus.

In scenario 6a as well, all E-bus models remain in loss for the first six years (i.e., during the loan tenure) while >10.5m length E-bus models from OEM 1, 2 & 3 and 8.5-10.5m length bus model from OEM 2 are profitable. Table 37 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a.

Table 37: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	-9.41	-12.61	-3.25	-6.14	-10.82	-17.54	-23.82	-16.18
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-29.42	-26.80	-19.89	-17.01	-17.49	-35.00	-37.93	-35.76
	Avg Profit / Loss in last 8 years	10.40	-0.10	13.19	3.43	-2.33	2.44	-4.26	-2.30
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-16.16	-16.48	-8.87	-9.21	-12.22	-21.65	-26.72	-23.64
	Avg Profit / Loss in last 6 years	10.40	-1.53	13.19	2.44	-2.55	1.55	-4.26	-3.28

3.2.4.4 Ownership Model for Route 4: Charbagh – Kanpur

The route length of Charbagh to Kanpur route is 96 km (refer Figure 37). The average (over the service life of the bus) EPK for this route is ₹ 30/km and the existing loss is ₹ -0.81/Km.
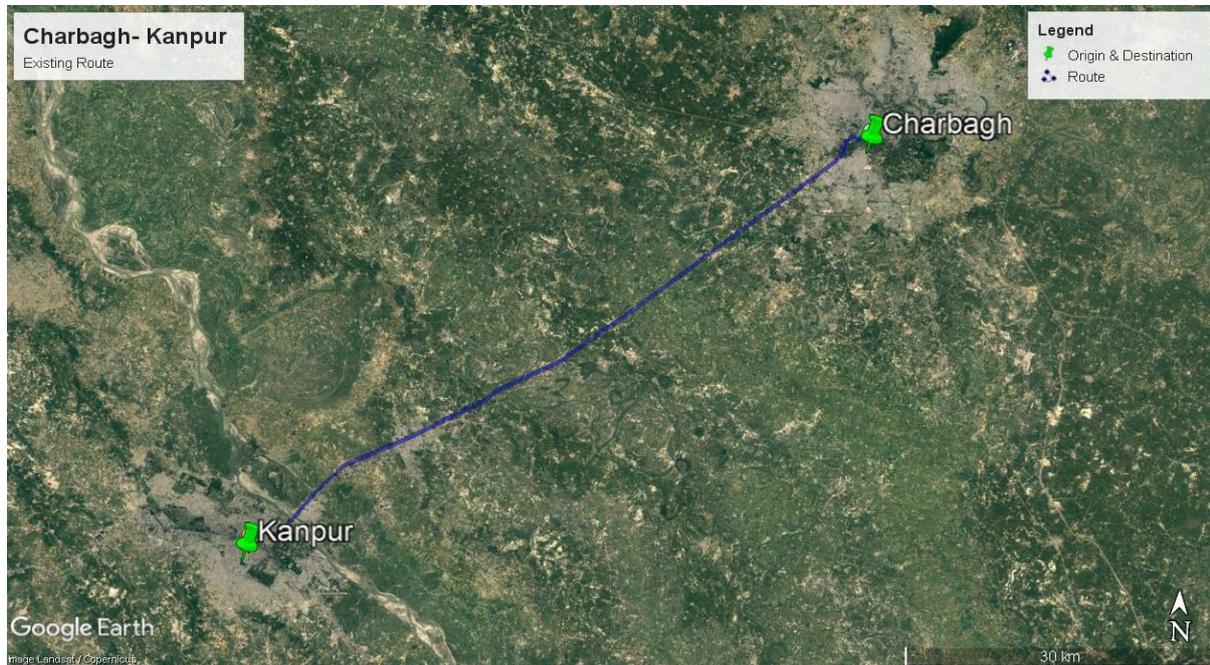
Figure 37: Route Map of existing Charbagh-Kanpur Route

The key findings from the comparative analysis (Figure 38) are:

- In scenario 1, 4, 5 & 6, only >10.5m (OEM 2) e-bus model is profitable
- In scenario 2, only >10.5m & 8.8-10.5m (OEM 2) e-bus models are profitable
- In scenario 3, >10.5m (OEM1, OEM 2 & OEM 3) and 8.5-10.5m (OEM 2) e-bus models are profitable
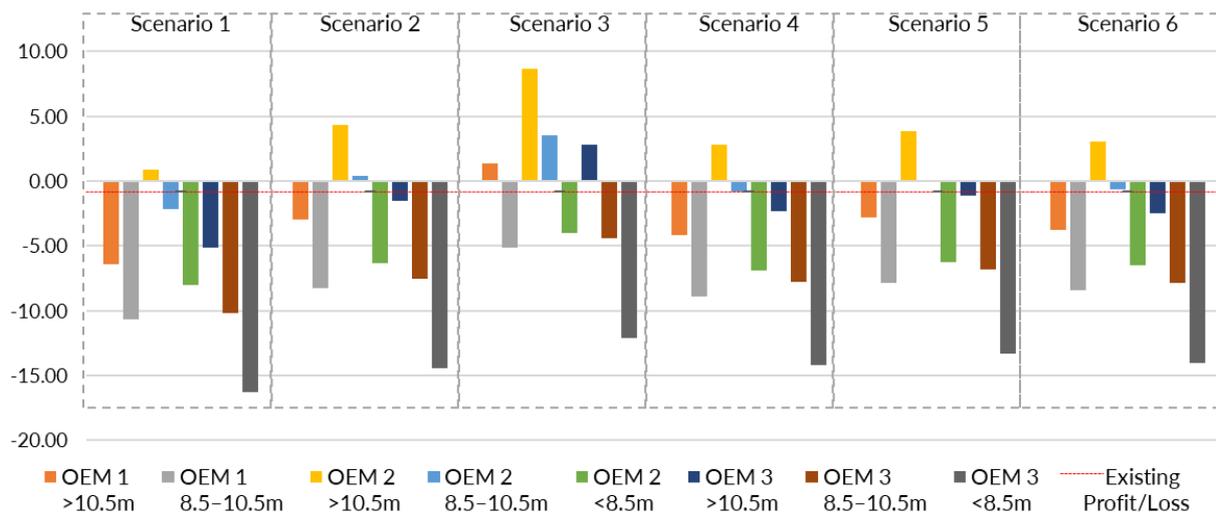
*Figure 38: Annual Profitability / Loss on each e-bus model for Charbagh to Kanpur route*

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, only >10.5 E-bus model from OEM 2 present average profitability over the entire service life of the bus

(12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that none of the E- bus models present average profit during the loan tenure. However, after the loan tenure only <8.5m length E-bus model from OEM 3 remain unprofitable and all other E-bus models over this period show average profits over the rest of the service life of the bus.

In scenario 6a, all E-bus models remain in loss for the first six years (i.e., during the loan tenure) whereas excluding <8.5m length E-bus model from OEM 3 all other models are profitable in last six years. Table 38 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a.

Table 38: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1			OEM 2		OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	-3.79	-8.41	3.03	-0.60	-6.47	-2.44	-7.86	-14.00
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-20.21	-19.09	-11.02	-9.73	-11.86	-27.29	-28.28	-29.06
	Avg Profit / Loss in last 8 years	11.79	4.18	16.00	8.78	2.12	19.72	7.29	-0.33
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-7.48	-10.27	-0.42	-2.34	-7.20	-11.63	-15.17	-18.27
	Avg Profit / Loss in last 6 years	9.72	3.11	14.40	7.56	2.12	19.72	6.03	-1.55

3.2.4.5 Ownership Model for Route 5: Charbagh – Barabanki

The route length of Charbagh to Barabanki route is 41 km (refer Figure 39). The average (over the service life of the bus) EPK for this route is ₹ 25/km and the existing loss is ₹ -0.23/Km.
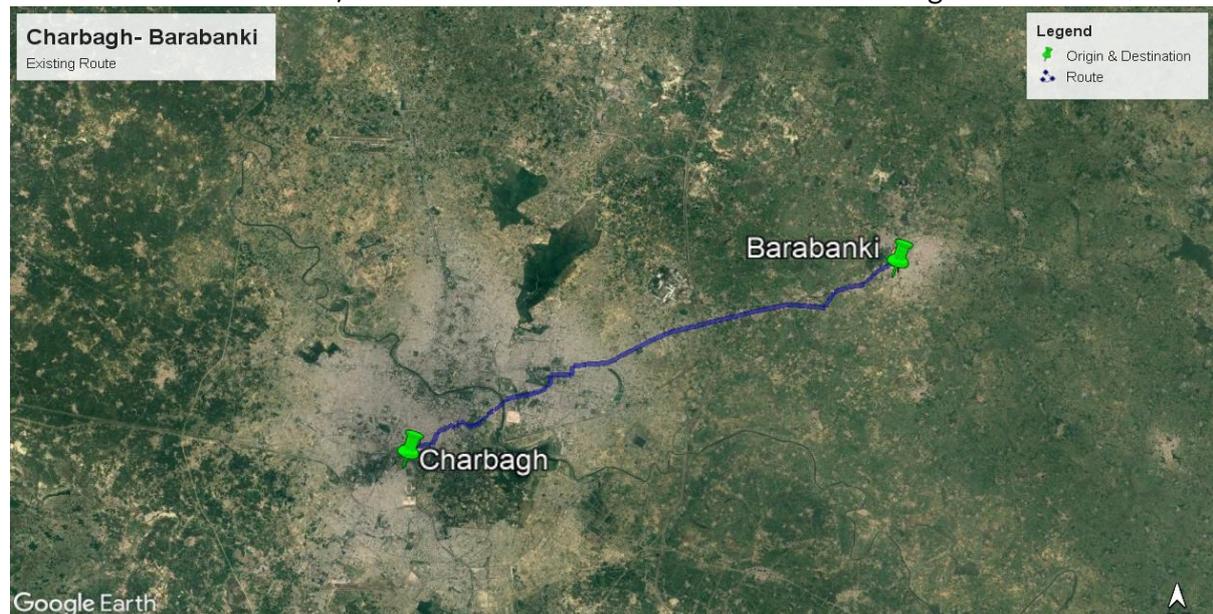

Figure 39: Route Map of existing Charbagh-Barabanki Route

The key findings from the comparative analysis (Figure 40) are:

- In scenario 1, none of the e-bus models are profitable
- In scenario 2, 4, 5 & 6, only >10.5m (OEM 2) e-bus model is profitable
- In scenario 3, all e-bus models are profitable except >10.5m (OEM 1 & OEM 3) and <8.5m (OEM 3)
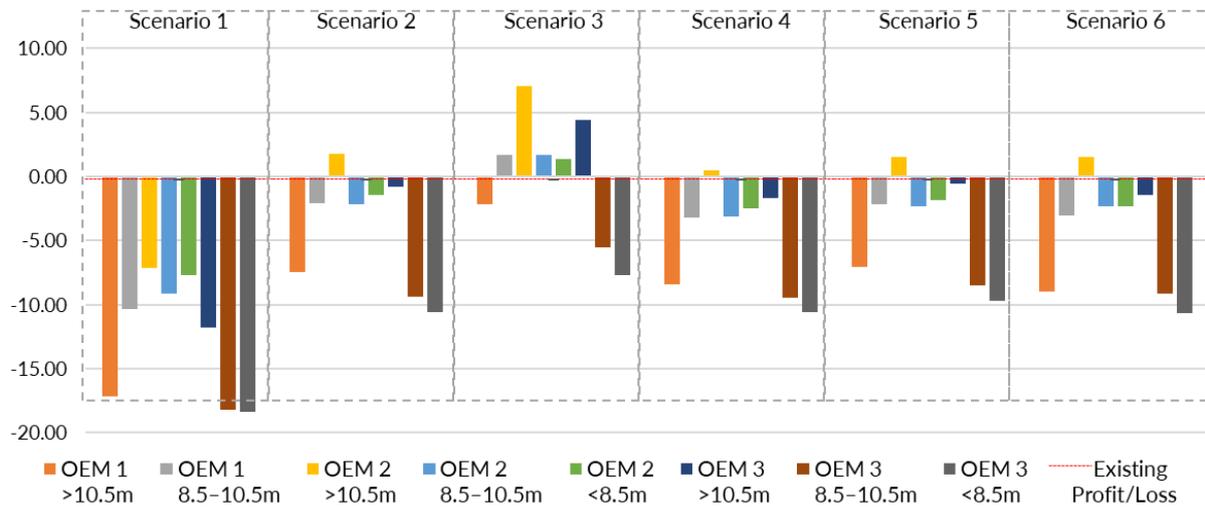
Figure 40: Annual Profitability / Loss on each e-bus model for Charbagh to Barabanki route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, only one E-bus model of >10.5m length from OEM 2 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that none of the E-bus models present average profitability during the loan tenure. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

In scenario 6a as well, except >10.5m length E-Bus model from OEM 2, all other E-Bus models remain in loss for the first six years (i.e., during the loan tenure) while all E-Bus models are profitable in last six years. Table 39 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a

Table 39: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	-9.02	-3.04	1.52	-2.31	-2.29	-1.47	-9.13	-10.69
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-1.09	-18.06	-8.66	-8.41	-10.40	-26.30	-28.56	-30.10
	Avg Profit / Loss in last 8 years	1.81	10.45	18.07	9.84	6.53	19.55	8.92	4.17

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-5.55	-7.00	0.24	-2.33	-3.60	-8.60	-13.91	-17.40
	Avg Profit / Loss in last 6 years	7.23	8.89	18.07	9.83	5.37	17.11	6.75	2.88

3.2.4.6 Lease Model for all Routes in Scenario 1

Based on discussion with various private operators, it is understood that operators are keen for alternate modes of ownership in order to cushion off the impact of initial capital investment. They look forward to a mix of wet and dry lease model where the lessor provides the bus, complete annual maintenance (including, servicing, maintenance, spares, tyres, battery replacement, etc.) and insurance, while the lessee provides the staff, pays for the energy, and pays any taxes/permit fees etc. Table 40 presents the expected maximum, lease cost per km for each of the routes in Uttar Pradesh, with a promised minimum average km of operations. It is estimated that at this price the operator will be able to make an average profit of ₹ 4.50 per km throughout the service life of the bus.

Table 40: Dewas Madhya Pradesh: Maximum Cost for Lease Models of E-Buses

Routes	Min. assured km per annum for each bus (In KM)	OEM 1 - E-bus (Lease cost in ₹ / km)			OEM 2 - E-bus (Lease cost in ₹ / km)			OEM 3 - E-bus (Lease cost in ₹ / km)		
		>10.5m	8.5-10.5m	>10.5m	8.5-10.5m	<8.5m	12m	8.5m	<8.5m
Charbagh - Ayodhya	95,703	4.18	-0.62	6.97	1.54	-2.38	5.89	0.19	-4.36
Alambagh - Prayagraj	1,24,483	31.23	18.12	34.02	20.37	10.96	33.38	19.61	9.92
Kaisarbagh - Bahraich	1,41,127	7.70	1.29	10.49	3.54	-1.40	9.84	2.78	-2.44
Charbagh - Kanpur	1,41,127	15.31	7.40	18.10	9.56	3.57	17.02	8.21	1.59
Charbagh - Barabanki	1,04,372	20.94	10.75	23.73	12.91	5.39	22.65	11.56	3.41

3.2.5 Kerala

Route details of seven routes for which business model has been developed in Kerala has been presented in Table 41.

Table 41: Route details of Tamil Nadu

S. No.	Origin	Destination	Route Length (Km)
1	Dewas	Ujjain	37
2	Dewas	Indore	40
3	Indore	Shujalpur	180
4	Indore	Biaora	193
5	Dewas	Neemuch	246

The per km profit or loss in ownership model for each e-bus model in Scenario 1, for each route of Kerala have been generated as average per km profit overall, i.e., average over 12 years' service life of bus, average during the first four years (during the loan tenure) and average during the following eight years (after the loan tenure). The same has been presented in Table 42. The details of business plans for each of these routes for all six scenarios has been presented in subsequent sub sections.

Table 42: Kerala: Per Km Profit/ Loss on each e-bus model in Scenario

Route Names	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m E-bus	<8.5m E-bus
Route 1: Thrissur-Kunnumkulam	**Overall Profit / Loss**	**-6.53**	**-3.09**	**2.79**	**-0.68**	**-0.54**	**-10.27**	**-8.45**	**-9.86**
	Avg Profit / Loss in first 4 years (₹/km)	-21.50	-20.44	-10.56	-9.10	-9.58	-32.21	-33.31	-32.97
	Avg Profit / Loss in last 8 years	15.85	12.65	21.66	12.86	9.54	16.69	12.25	7.42
Route 2: Aluva-Kothamangalam	**Overall Profit / Loss**	**-2.74**	**-9.64**	**5.86**	**1.51**	**-6.29**	**-8.39**	**-16.64**	**-15.75**
	Avg Profit / Loss in first 4 years (₹/km)	-28.30	-25.97	-15.83	-12.92	-15.22	-39.88	-40.30	-39.14
	Avg Profit / Loss in last 8 years (₹/km)	19.78	8.49	24.50	14.67	6.45	19.29	7.22	3.91
Route 3: Thodupuzha-Kottayam	**Overall Profit / Loss**	**-6.07**	**-1.77**	**4.07**	**-1.87**	**-0.05**	**-2.25**	**-12.45**	**-12.21**
	Avg Profit / Loss in first 4 years (₹/km)	-32.08	-31.07	-17.99	-16.21	-17.84	-45.87	-47.92	-47.48
	Avg Profit / Loss in last 8 years (₹/km)	21.15	20.75	26.63	14.10	14.01	37.08	13.42	12.03
Route 4: Thodupuzha-Pala	**Overall Profit / Loss**	**10.60**	**-2.61**	**19.55**	**10.08**	**5.28**	**7.14**	**-6.66**	**-11.71**
	Avg Profit / Loss in first 4 years (₹/km)	-12.78	-16.87	-0.31	-2.94	-7.15	-24.36	-30.31	-32.84
	Avg Profit / Loss in last 8 years (₹/km)	33.66	16.70	38.65	23.59	15.83	34.82	17.21	8.51
Route5: Thodupuzha-Muvattupuzha	**Overall Profit / Loss**	**4.85**	**-0.59**	**14.98**	**6.06**	**-0.28**	**8.66**	**-4.52**	**-11.53**
	Avg Profit / Loss in first 4 years (₹/km)	-21.16	-23.14	-7.08	-8.27	-11.89	-34.96	-39.99	-41.53
	Avg Profit / Loss in last 8 years (₹/km)	32.07	19.69	37.54	22.04	12.74	47.99	21.36	10.73
Route 6: Kottayam-Pala	**Overall Profit / Loss**	**4.85**	**2.06**	**14.98**	**6.06**	**2.23**	**0.21**	**-4.52**	**-9.48**

| Route Names | Parameters | OEM 1 | | OEM 2 | | | OEM 3 | | |
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m E-bus	<8.5m E-bus
	Avg Profit / Loss in first 4 years (₹/km)	-21.16	-23.14	-7.08	-8.27	-11.89	-34.96	-39.99	-41.53
	Avg Profit / Loss in last 8 years (₹/km)	32.07	21.67	37.54	22.04	14.62	32.89	21.36	12.26
Route 7: Kottayam-Ernakulam	**Overall Profit / Loss**	**24.39**	**11.24**	**31.13**	**17.87**	**8.05**	**13.63**	**-2.23**	**-0.87**
	Avg Profit / Loss in first 4 years (₹/km)	-0.25	-7.23	10.29	3.64	-2.81	-9.17	-20.00	-23.76
	Avg Profit / Loss in last 8 years (₹/km)	46.00	28.31	48.79	30.47	16.26	36.37	18.26	17.05

3.2.5.1   Ownership Model for Route 1: Thrissur – Kunnumkulam

The route length of Thrissur to Kunnumkulam route is 31 km (refer Figure 41). The average (over the service life of the bus) EPK for this route is ₹ 36/km and the existing profit is ₹ 1.90/Km.
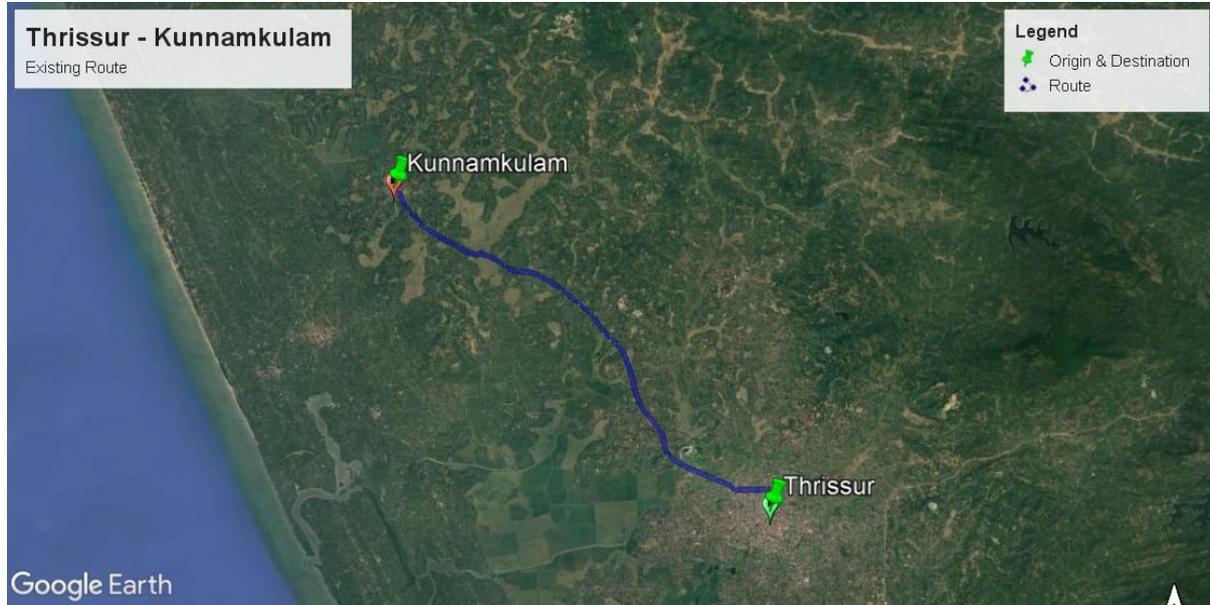

Figure 41: Route Map of existing Thrissur-Kunnumkulam Route

The key findings from the comparative analysis (Figure 42) are:

- In scenario 1, only >10.5m (OEM 2) e-bus model are profitable
- In scenario 2, >10.5m (OEM 3) and OEM 2 all models are profitable
- In scenario 3, all e-bus models are profitable except 8.5-10.5m & <8.5m (OEM 3)
- In scenario 4, 5 & 6 only OEM 2 all e-bus models are profitable
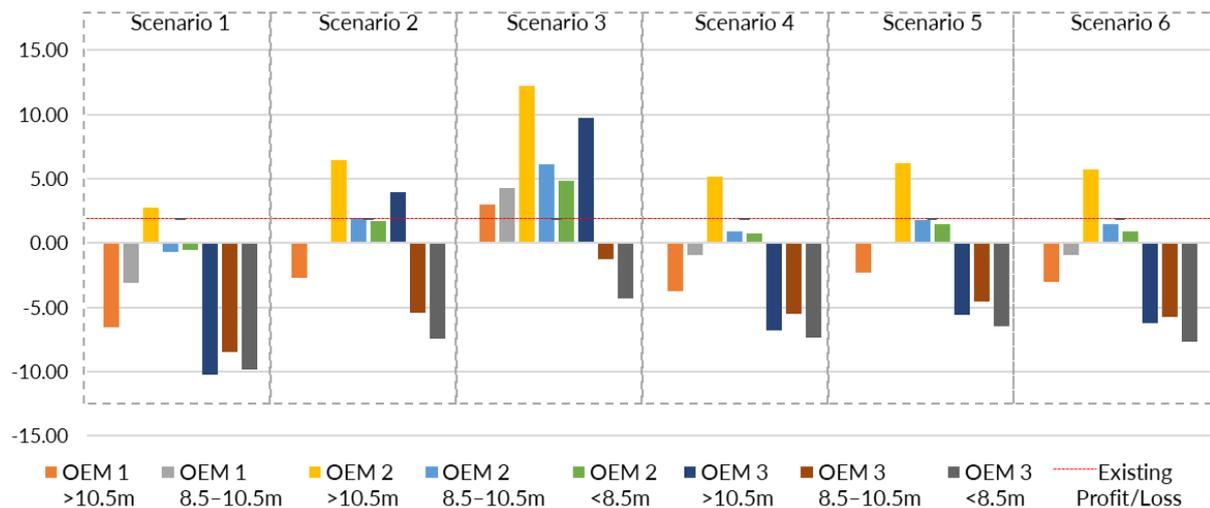
Figure 42: Annual Profitability / Loss on each e-bus model for Thrissur - Kunnumkulam route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, except OEM 1 & 3, all OEM 2 E-Bus models i.e., >10.5m, 8.5m-10.5m and <8.5m length present average profitability over the entire service life of the bus (12 years). However, when a breakup

of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that all E-Bus model remain unprofitable over this period. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

However, in scenario 6a, except two E-Bus models, i.e., >10.5m length and 8.5-10.5m length from OEM 2, all other buses remain in loss for the first six years (i.e., during the loan tenure) while all E-Bus models are profitable in last six years. Table 43 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a.

Table 43: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	-3.01	-0.94	5.70	1.44	0.93	-6.24	-5.71	-7.69
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-16.56	-16.65	-6.39	-6.18	-7.25	-26.10	-28.22	-28.62
	Avg Profit / Loss in last 8 years	17.26	13.31	22.78	13.71	10.07	18.18	13.03	7.95
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-4.99	-4.55	3.32	0.44	-1.25	-11.36	-12.00	-14.72
	Avg Profit / Loss in last 6 years	16.94	11.19	22.77	13.71	9.84	18.17	10.54	6.24

3.2.5.2 Ownership Model for Route 2: Aluva – Kothamangalam

The route length of Aluva to Kothamangalam route is 38 km (refer Figure 43). The average (over the service life of the bus) EPK for this route is ₹ 35/km and the existing profit is ₹ 1.90/Km.
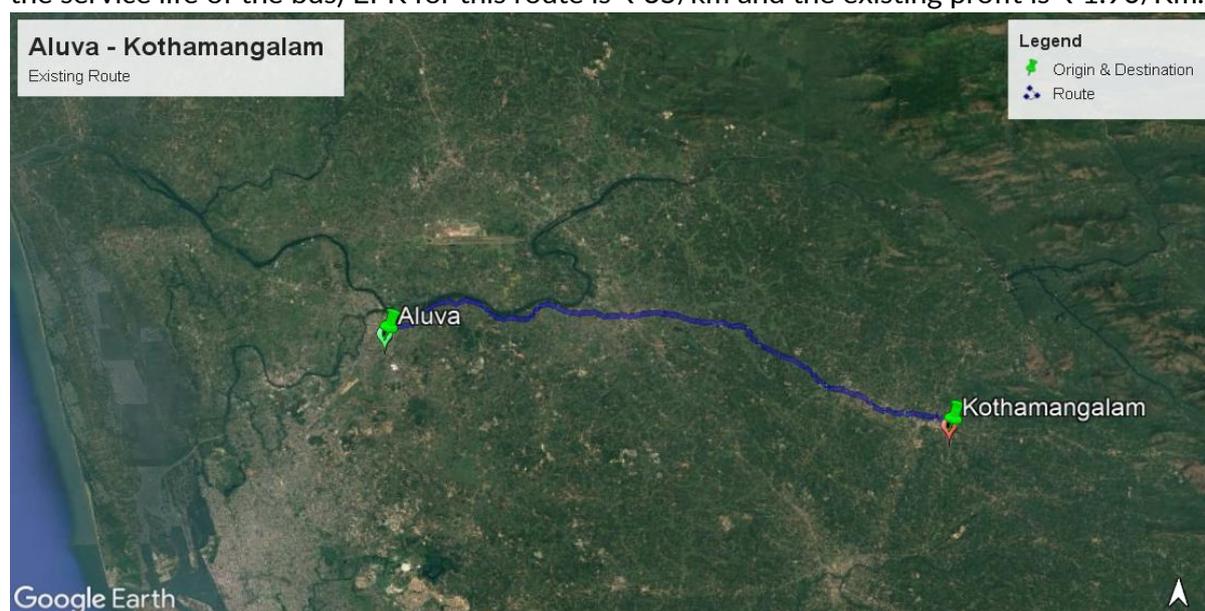

Figure 43: Route Map of existing Aluva-Kothamangalam Route

The key findings from the comparative analysis (Figure 44) are:

- In scenario 1, only >10.5m & 8.5-10.5m (OEM 2) e-bus models are profitable
- In scenario 3, >10.5m (OEM1, OEM 2 & OEM 3) and 8.5-10.5m (OEM 2) e-bus models are profitable
- In scenario 2, 4, 5 & 6 only >10.5m (OEM 1 & OEM 2) and 8.5-10.5m (OEM 2) e-bus models are profitable
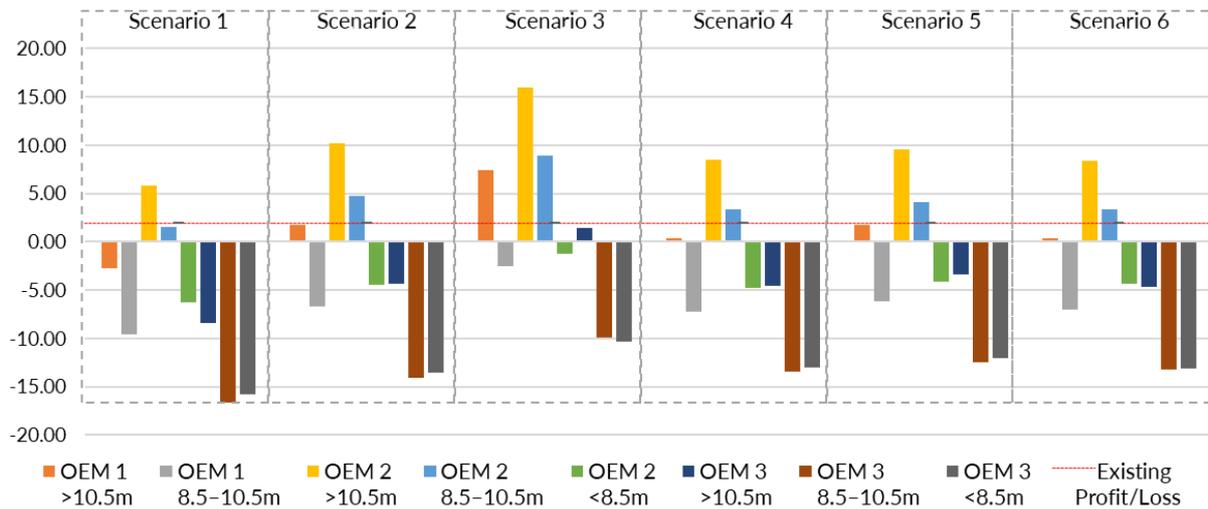

Figure 44: Annual Profitability / Loss on each e-bus model for Aluva to Kothamangalam route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, only >10.5m length E-Bus models from OEM 1 & OEM 2 and 8.5-10.5m length E-Bus from OEM 2 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that none of the E-Bus models present average profit during the loan tenure. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

However, in scenario 6a, except >10.5m and 8.5-10.5m length E-Bus models from OEM 2, all other buses remain in loss for the first six years (i.e., during the loan tenure). Table 44 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a

Table 44: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	0.31	-6.98	8.36	3.32	-4.39	-4.64	-13.25	-13.14
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-22.84	-21.77	-11.28	-9.75	-12.47	-33.16	-34.67	-34.32

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
	Avg Profit / Loss in last 8 years	20.70	9.43	25.24	15.23	7.15	20.42	8.36	4.66
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-5.40	-10.48	3.23	0.36	-5.94	-11.72	-19.88	-20.06
	Avg Profit / Loss in last 6 years	17.76	8.53	22.88	13.44	7.15	16.81	7.90	3.38

3.2.5.3 Ownership Model for Route 3: Thodupuzha – Kottayam

The route length of Thodupuzha to Kottayam route is 60 km (refer Figure 45). The average (over the service life of the bus) EPK for this route is ₹ 50/km and the existing profit is ₹ 4.16/Km.
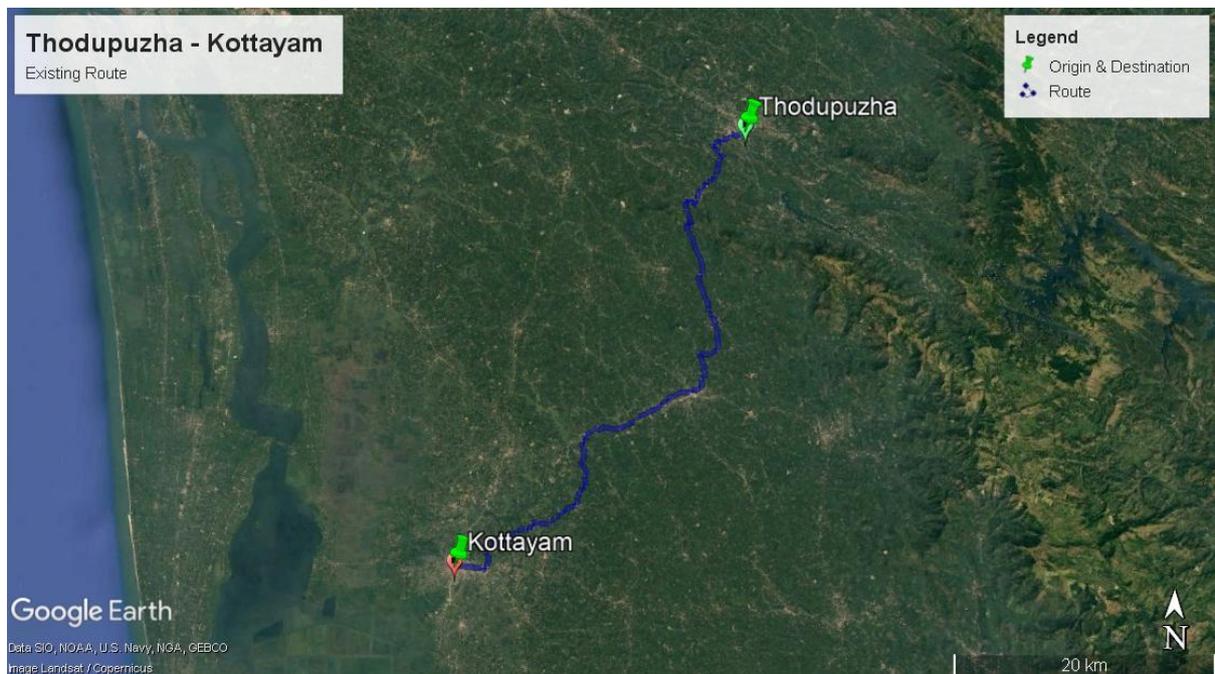

Figure 45: Route Map of existing Thodupuzha-Kottayam Route

The key findings from the comparative analysis (Figure 46) are:

- In scenario 1, only >10.5m (OEM 2) e-bus model is profitable
- In scenario 3, all e-bus models are profitable except 8.5-10.5m & <8.5m (OEM 3)
- In scenario 2, 4, 5 & 6 all e-bus models are profitable except >10.5m (OEM 1 & OEM 3) and <8.5m (OEM 3)
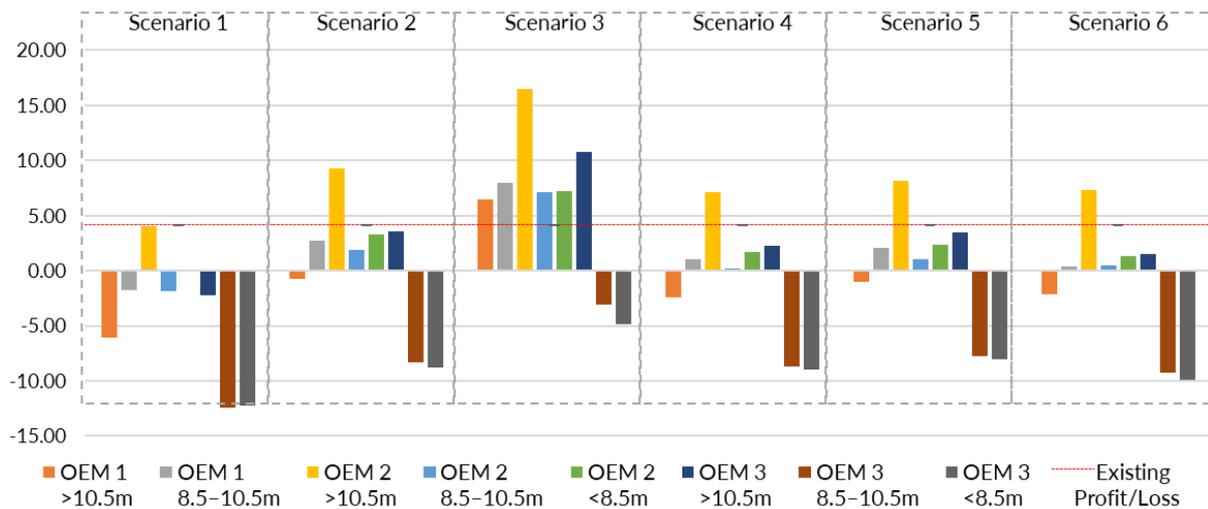
Figure 46: Annual Profitability / Loss on each e-bus model for Thodupuzha to Kottayam route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, all models except for >10.5m length model for OEM 1 and 8.5-10.5m and <8.5m length model for OEM 3 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that during the loan tenure, all E-Bus models remain unprofitable over this period. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

However, in scenario 6a, only one model, i.e., >10.5m length from OEM 2 is profitable in the first six years (i.e., during the loan tenure) while all other models are in loss. Table 45 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a.

Table 45: Average Profit / Loss for each Bus Model

| Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	-2.15	0.36	7.29	0.47	1.28	1.47	-9.24	-9.92
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-25.70	-26.18	-12.68	-12.51	-14.83	-38.03	-41.36	-41.86
	Avg Profit / Loss in last 8 years	22.50	20.75	27.72	14.93	14.01	37.08	14.19	12.03
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	-5.36	-10.54	3.31	-1.63	-5.22	-13.01	-20.40	-23.90
	Avg Profit / Loss in last 6 years	18.20	20.75	25.18	13.19	14.01	37.08	11.73	12.03

3.2.5.4 Ownership Model for Route 4: Thodupuzha – Pala

The route length of Thodupuzha to Pala route is 28 km (refer Figure 47). The average (over the service life of the bus) EPK for this route is ₹ 47.5/km and the existing profit is ₹ 4.76/Km.
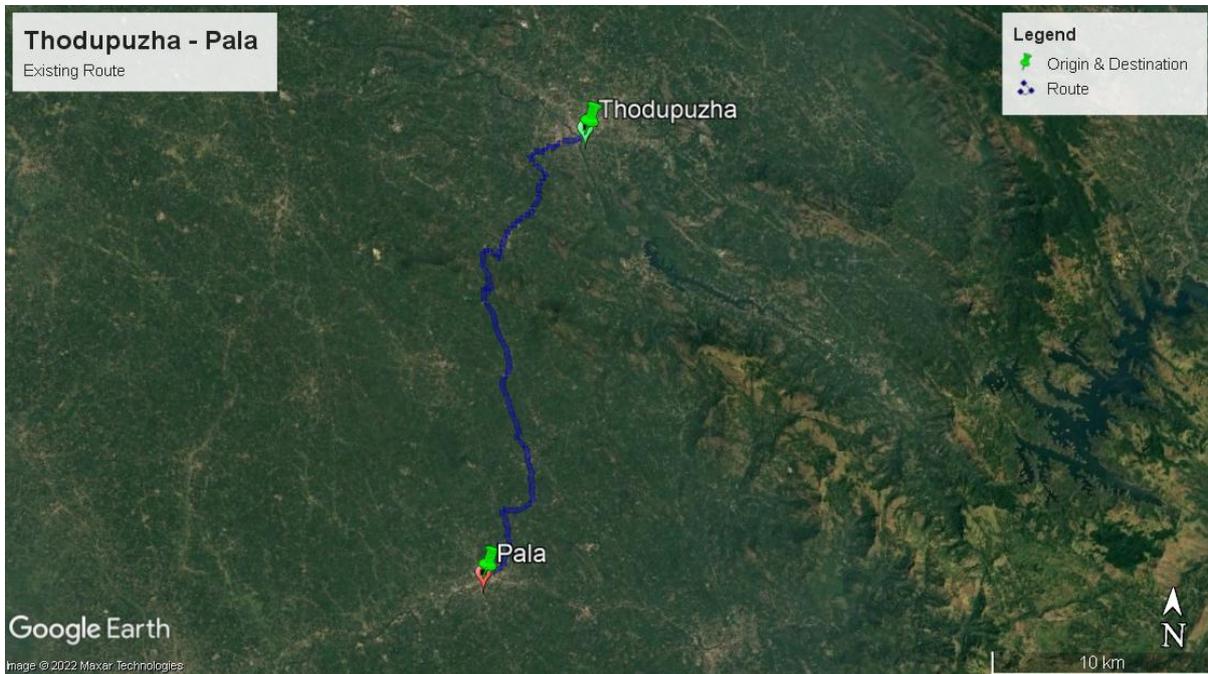
Figure 47: Route Map of existing Thodupuzha-Pala Route

The key findings from the comparative analysis (Figure 48) are:

- In scenario 1 & 4, all e-bus models are profitable except 8.5-10.5m (OEM 1 & 3) and <8.5m (OEM 3)
- In scenario 2, 5 & 6 all e-bus models are profitable except 8.5-10.5m & <8.5m (OEM 3)
- In scenario 3, all e-bus models are profitable except <8.5m (OEM 3)
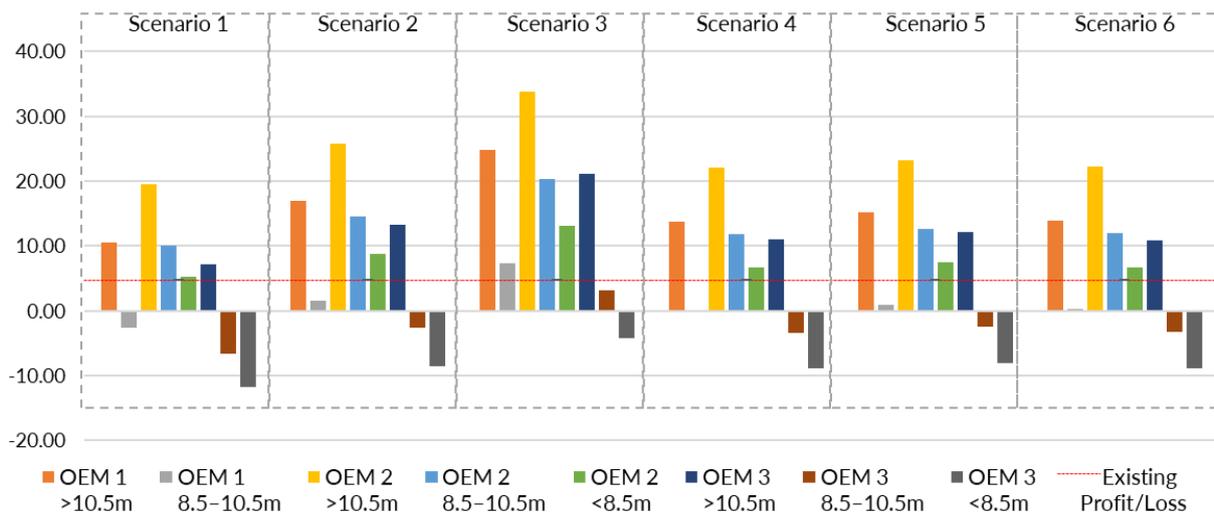
Figure 48: Annual Profitability / Loss on each e-bus model for Thodupuzha to Pala route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, all models except for 8.5-10.5m and <8.5m length model for OEM 3 present average profitability over the

entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that >10.5m and 8.5-10.5m length E-Bus model for OEM 2 present average profit during the loan tenure while all other remain unprofitable over this period. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

Whereas, in scenario 6a, except for 8.5m-10.5m length model for OEM 1 & 3 and <8.5m length model for OEM 3, all other models remain in loss. Table 46 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a.

Table 46: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1 >10.5m E-bus	8.5-10.5m	OEM 2 >10.5m E-bus	8.5-10.5m	<8.5m E-bus	OEM 3 >10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	13.86	0.32	22.22	12.02	6.69	10.88	-3.26	-8.89
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-7.31	-12.59	4.24	0.23	-4.57	-17.64	-24.68	-28.02
	Avg Profit / Loss in last 8 years	34.74	17.81	39.52	24.26	16.23	35.94	18.34	9.42
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	10.12	-2.47	18.76	10.34	3.67	3.81	-9.90	-15.44
	Avg Profit / Loss in last 6 years	31.30	17.80	36.74	22.15	14.93	32.34	17.89	9.31

3.2.5.5 Ownership Model for Route 5: Thodupuzha – Muvattupuzha
The route length of Thodupuzha to Pala route is 20 km (refer Figure 49). The average (over the service life of the bus) EPK for this route is ₹ 50/km and the existing profit is ₹ 4.16/Km.
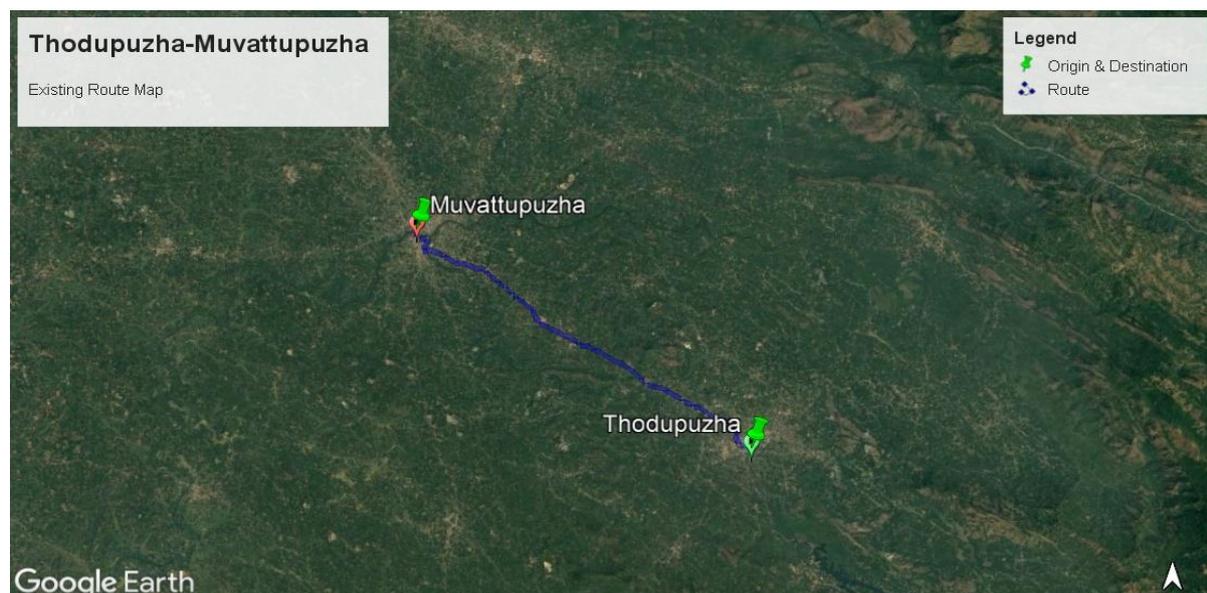
Figure 49: Route Map of existing Thodupuzha-Muvattupuzha Route

The key findings from the comparative analysis (Figure 50) are:

- In scenario 1, >10.5m (OEM 1,2 & 3) and 8.5-10.5m (OEM 2) e-bus models are profitable
- In scenario 2, & 3 all e-bus models are profitable except <8.5m (OEM 3)
- In scenario 4, 5 & 6 all e-bus models are profitable except 8.5-10.5m & <8.5m (OEM 3)
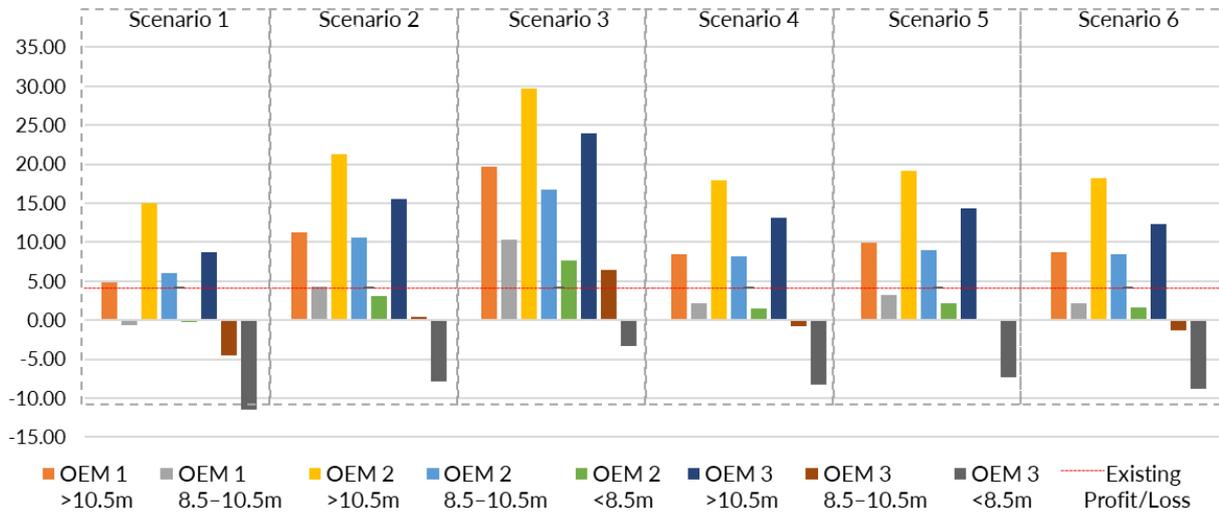
Figure 50: Annual Profitability / Loss on each e-bus model for Thodupuzha to Pala route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, only 2 E-Bus models i.e., 8.5-10.5m and <8.5m length model for OEM 3 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed that none of the E-Bus models present average profit during the loan tenure. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

Whereas, in scenario 6a, only three bus models, i.e., <10.5 length for OEM 1 & 2 and 8.5-10.5m length for OEM 2 remain profitable for the first six years (i.e., during the loan tenure) while all other models remain in loss. Table 47 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a

Table 47: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	8.76	2.18	18.20	8.40	1.63	12.38	-1.30	-8.74
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-14.79	-18.24	-1.77	-4.58	-8.88	-27.12	-33.42	-35.90
	Avg Profit / Loss in last 8 years	33.41	20.54	38.63	22.87	13.43	47.99	22.12	11.42

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	5.56	-2.61	14.22	6.31	-1.19	-2.10	-12.46	-17.95
	Avg Profit / Loss in last 6 years	29.11	17.82	36.09	21.12	13.17	47.99	19.67	9.22

3.2.5.6   Ownership Model for Route 6: Kottayam – Pala

The route length of Kottayam to Pala route is 30 km (refer Figure 51). The average (over the service life of the bus) EPK for this route is ₹ 50/km and the existing profit is ₹ 4.16/Km.
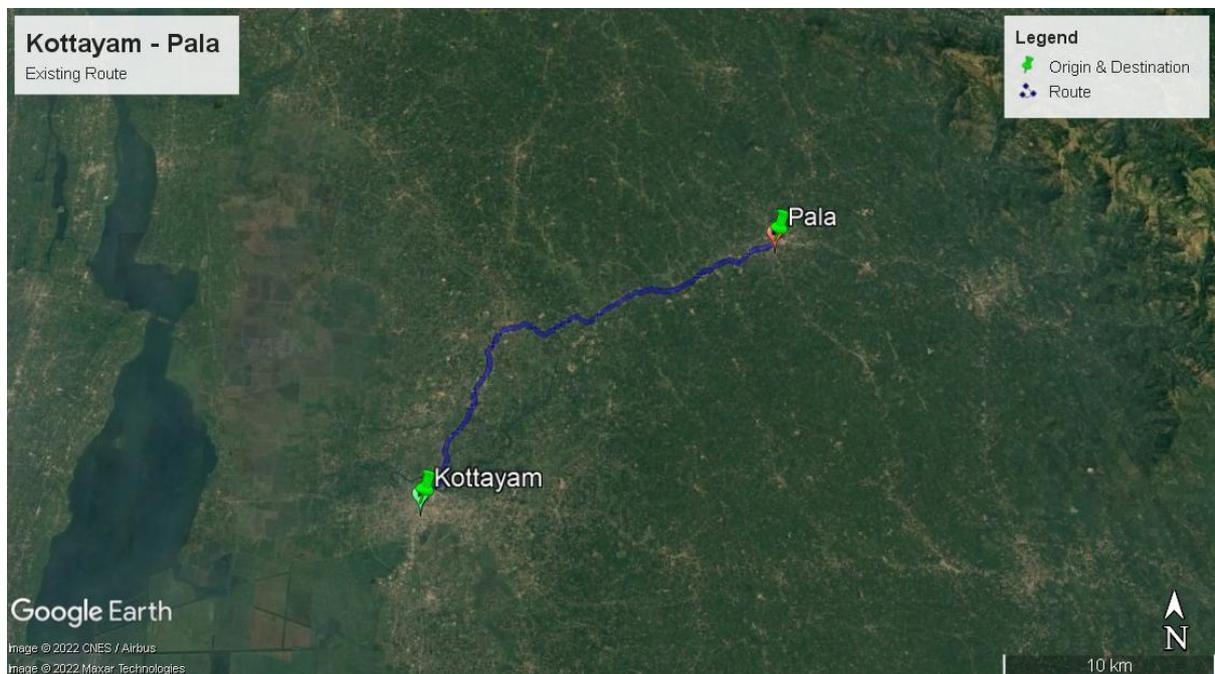

Figure 51: Route Map of existing Kottayam-Pala Route

The key findings from the comparative analysis (Figure 52) are:

- In scenario 1, all e-bus models are profitable except 8.5-10.5m & <8.5m (OEM 3)
- In scenario 2, & 3 all e-bus models are profitable except <8.5m (OEM 3)
- In scenario 4, 5 & 6 all e-bus models are profitable except 8.5-10.5m & <8.5m (OEM 3)
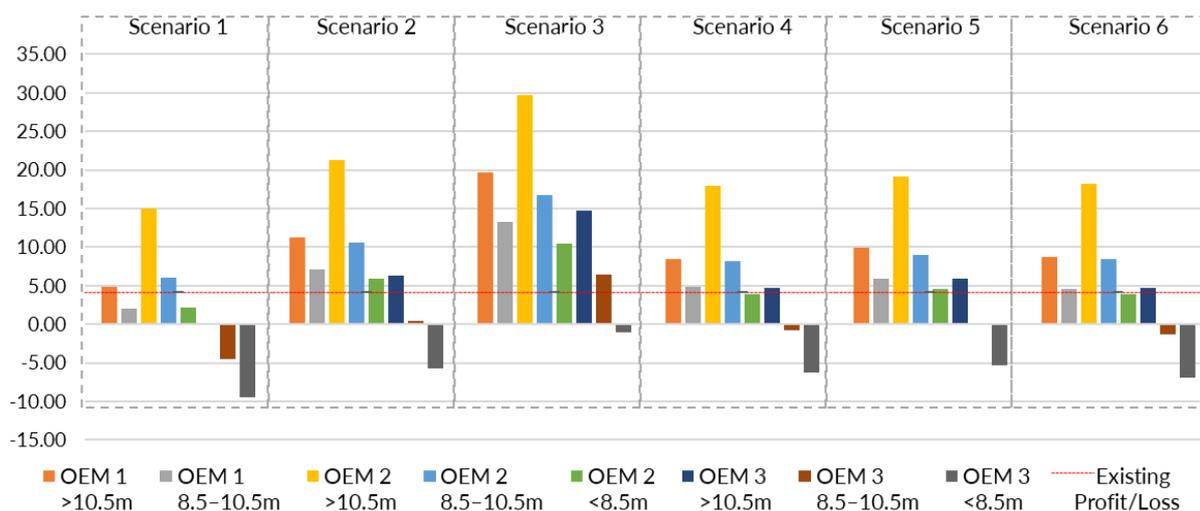
Figure 52: Annual Profitability / Loss on each e-bus model for Kottayam to Pala route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, all models except for 8.5m-10.5m length model for OEM 3 and <8.5m length model for OEM 3 present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan tenure (last eight years), it is observed all bus models remain unprofitable over this period. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

However, in scenario 6a, four models, i.e., 8.5-10.5m length for OEM 1 & 3, >10.5m & <8.5m length from OEM 3 remain unprofitable for the first six years (i.e., during the loan tenure) while all other models are showing profit. Table 48 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a

Table 48: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	8.76	4.58	18.20	8.40	3.90	4.72	-1.30	-6.88
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	-14.79	-18.24	-1.77	-4.58	-8.88	-27.12	-33.42	-35.90
	Avg Profit / Loss in last 8 years	33.41	22.33	38.63	22.87	15.13	34.32	22.12	12.80
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	5.56	-2.61	14.22	6.31	0.73	-2.89	-12.46	-17.95
	Avg Profit / Loss in last 6 years	29.11	20.21	36.09	21.12	13.51	30.54	19.67	11.08

3.2.5.7 Ownership Model for Route 7: Kottayam - Ernakulam

The route length of Kottayam to Ernakulam route is 70 km (refer Figure 53). The average (over the service life of the bus) EPK for this route is ₹ 50/km and the existing profit is ₹ 5.29/Km.
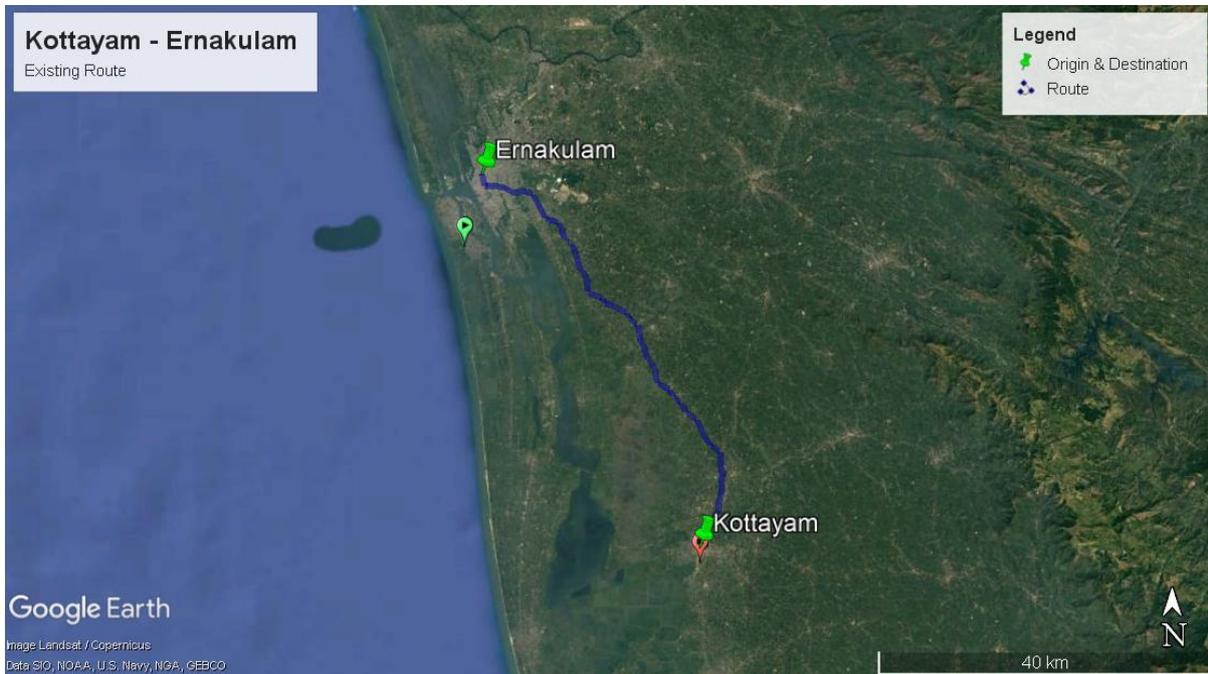

Figure 53: Route Map of existing Kottayam-Ernakulam Route

The key findings from the comparative analysis (Figure 54) are:

- In scenario 1, all e-bus models are profitable except 8.5-10.5m & <8.5m (OEM 3)
- In scenario 2, 3, 4, 5 & 6 all e-bus models are profitable
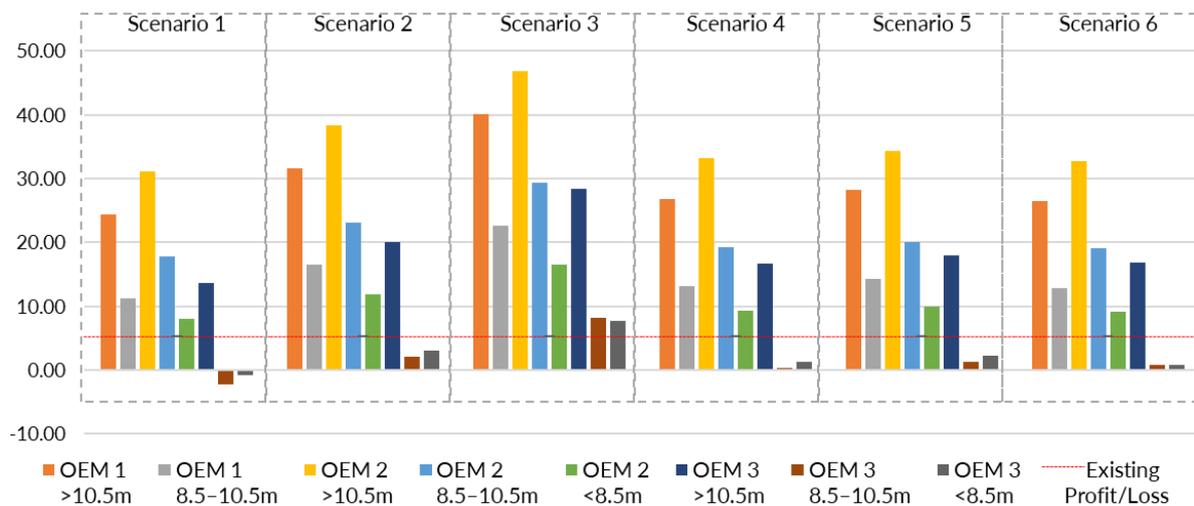
Figure 54: Annual Profitability / Loss on each e-bus model for Kottayam to Ernakulam route

For all scenarios the loan tenure has been taken as four years. The analysis suggests that when interest rate is discounted by 25% and loan tenure remains unchanged in scenario 6, all models present average profitability over the entire service life of the bus (12 years). However, when a breakup of average profit is observed for the loan tenure (first four years) and after the loan

tenure (last eight years), it is observed that 8.5-10.5m length (for OEM 1,2 &3), <8.5m length (for OEM 2 & 3) and >10.5m length from OEM 3 bus models remain unprofitable over this period. However, after the loan tenure all buses show average profits over the rest of the service life of the bus.

However, in scenario 6a, only two models, i.e., 8.5-10.5m & <8.5m length from OEM 3 remain unprofitable for the first six years (i.e., during the loan tenure) while all other models are showing profit. Table 49 presents a comparative assessment in terms of the per km average profit/loss for each bus model over the service life, in both scenario 6 and scenario 6a

Table 49: Average Profit / Loss for each Bus Model

Scenario 6	Parameters	OEM 1		OEM 2			OEM 3		
		>10.5m E-bus	8.5-10.5m	>10.5m E-bus	8.5-10.5m	<8.5m E-bus	>10.5m E-bus	8.5-10.5m	<8.5m E-bus
SC 6: Average over 12 years	Overall Profit / Loss	26.43	12.86	32.80	19.06	9.09	16.85	0.73	0.82
SC 6 :4yrs & 25%	Avg Profit / Loss in first 4 years	4.13	-3.87	13.93	6.18	-0.75	-3.79	-15.36	-19.90
	Avg Profit / Loss in last 8 years	46.00	28.31	48.79	30.47	16.52	37.44	19.28	17.05
SC 6a :6yrs & 50%	Avg Profit / Loss in first 6 years	18.08	6.85	25.54	14.27	5.84	11.58	-3.82	-7.59
	Avg Profit / Loss in last 6 years	46.00	28.31	48.79	30.47	15.68	35.80	19.28	17.05

3.2.5.8   Lease Model for all Routes in Scenario 1

Based on discussion with various private operators, it is understood that operators are keen for alternate modes of ownership to cushion off the impact of initial capital investment. They look forward to a mix of wet and dry lease model where the lessor provides the bus, complete annual maintenance (including, servicing, maintenance, spares, tyres, battery replacement, etc.) and insurance, while the lessee provides the staff, pays for the energy, and pays any taxes/permit fees etc. Table 50 presents the expected maximum, lease cost per km for each of the routes in Kerala, with a promised minimum average km of operations. It is estimated that at this price the operator will be able to make an average profit of ₹ 4.50 per km throughout the service life of the bus.

Table 50: Kerala: Maximum Cost for Lease Models of E-Buses

Routes	Min. assured km per annum for each bus (In KM)	OEM 1 - E-bus (Lease cost in ₹ / km)		OEM 2 - E-bus (Lease cost in ₹ / km)			OEM 3 - E-bus (Lease cost in ₹ / km)		
		>10.5m	8.5-10.5m	>10.5m	8.5-10.5m	<8.5m	12m	8.5m	<8.5m
Thrissur – Kunnumkulam	1,07,493	30.80	19.52	33.59	21.68	13.43	32.51	20.33	11.45
Aluva – Kothamangalam	97,090	29.96	18.64	32.75	20.80	12.53	31.67	19.45	10.55
Thodupuzha – Kottayam	83,220	36.67	21.74	39.46	23.90	13.23	38.38	22.55	11.25
Thodupuzha – Pala	97,090	45.50	28.64	48.29	30.80	18.84	47.21	29.45	16.86
Thodupuzha – Muvattupuzha	83,220	47.58	29.67	50.37	31.83	19.18	49.29	30.48	17.20
Kottayam – Pala	83,220	47.58	29.67	50.37	31.83	19.18	49.29	30.48	17.20
Kottayam - Ernakulam	1,21,363	45.48	27.57	48.27	29.73	17.08	47.19	28.38	15.10

4 Findings

Comparative analysis of the outputs generated by the business model for different types of buses on different routes generates some interesting findings. These have been listed below.

- Longer buses are likely to be more profitable for operators than shorter buses, especially on high demand routes. For most routes, buses shorter than 8.5m length are unlikely to be viable. However, 8.5 to 10.5m length buses can be cost effective on most routes but will be less viable than 12m buses on high demand routes. This is because, the increase in per km earnings from passenger fare by these buses (12m buses may have a higher capacity than a 9m bus by up to 10-15 passengers) offsets higher capital cost and higher energy consumptions (due to increased weight).

- While for ICE vehicles, 2/3rd of the total cost of ownership for a private operator is attributed to the cost of fuel. However, in the case of electric buses between half to 2/3rd of the TCO (for different bus models) can be attributed to the capital and maintenance cost. Here the battery replacement cost is the highest contributor in maintenance cost and cost of battery also comprises about 40% of the capital cost of the bus. Hence like Diesel/CNG price plays the most significant role in influencing profitability for private operators on non-urban routes, in case of electric buses, this role is played by the cost of battery.

- The efficiency or the per km energy consumption rate of an electric bus has a significant impact on the profitability. This is not just because of the direct effect of energy cost, but also because of the impact on battery life. Less efficient buses would result in relatively high depth of discharge or increase charging cycles (Andersson, 2017), both impact the battery life and thus lower efficiency can lead to increase in maintenance cost. Reduced efficiency impact on maintenance cost can be the same or up to 3 times in comparison to the impact on energy cost.

- Higher profitability for e-buses on hills – Comparison of outputs from UT of Ladakh and other states suggests that operational cost saving by electric buses on hilly terrain is higher than on flat terrains. This reflects in the mileage figures for the State which is almost half of that in plains (refer chapter 2). This is part because of the terrain (ICE engines require more horsepower and thus more fuel is consumed on uphill, though no significant savings are achieved on downhill when the engine still idles) and part because of high altitude (Wang et al., 2013). However, the electric vehicle achieves almost identical mileage in hill s as in planes on an average[7]. This is because the energy is regenerated and restored in the batteries during descent (refer report on Pilot Bus Operations in UT of Ladakh, Annexure to this piece). This means that the CPK of diesel buses in hills can increase by as much as ₹ 15 - 30 per km in the hill s against in plains. However, there is no significant difference for electric vehicles, resulting in that much more cost saving over a similar ICE fleet.

- Capital cost of an e-bus is the key determinant of its viability for operators. Operators with buses from more expensive OEMs may be unable to offset this cost by any

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[7] Electric vehicles have been found to regenerate electricity on slopes with downhill gradients steeper than -2.6%. 38% additional energy is consumed per 1% increase in gradient in an uphill drive as compared to flat drive and 38% of energy reduction is observed per 1% decrease in gradient in a downhill drive. The findings of this are included in a separate report. This means that additional energy consumed in an uphill drive is compensated on the drive down in the hills in a return journey by an electric bus. Thus, no increase in energy or operational cost is observed as compared to flat terrain. This was derived from test conducted as part of pilots in this study.

supplementing bus features. Thus, OEMs offering cheaper versions of the bus models (including non-AC versions) may be preferred by the operators (especially private operators).

- Lease model is an attractive ownership model of electric buses for private operators. This is because it cushions the impact of high capital requirement, especially during the loan tenure for the bus. Estimates show that the annual earning for a lessor on leasing a 12m bus can be in excess of Rs. 35 lakh (3.5 million) per annum. This can easily pay for the capital cost of the bus, as well as maintenance and insurance cost of the bus, leading to a win-win situation for both the lessor and the lessee.

- It is critical for operators that the operational time for the bus is maximised, in order to maximise earnings. This means that the layover time induced by opportunity charging requirements especially for non-urban services needs to be minimised. This not only underscores the need for faster chargers (in excess of 200 kw-h rating) as well batteries that can accept that rate of charge, but also charging systems that can maintain a high charge rate at higher state of charge (SoC).

- A comparative analysis of the business model for buses with different battery sizes and different energy consumption rate on different routes, suggests that battery life or number of battery replacements can be optimised by customising battery size/capacity, seating capacity, etc. as per route requirements, including placement /availability of charging stations. This is critical for maximising profits. This underscores the demand of the operators to have more customisation options for e-buses.

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