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People Perception towards Adoption of Electric Vehicle in Kathmandu Valley

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Abstract
Electric vehicles and electric public transport altogether is a major part of sustainable urban mobility and it also uplifts the quality of life of people. This research aims to find perceptions, attitudes and behavioral intentions towards mass adoption of electric vehicles and identify advantages and barriers to consumer adoption. The findings of this paper can help in understanding perception and adoption in a developing country scenario where electric vehicles are still in early market phase. Questionnaire survey was conducted and 251 people were interviewed regarding their perception on adoption of electric vehicles. The indicators used to perception was socio-demographics, human travel behavior, experience of using electric vehicles, attitude, behavior, knowledge, awareness and public transportation (accessibility, availability, affordability, safety and comfort). It was analyzed using Likert's scale from 1-5 rating and further SPSS was used for regression and correlation analysis for perception analysis. Log Frame analysis was done for qualitative analysis. Although findings show people having positive affinity for sustainability (73.7%) and electric vehicles, very few (only 8%) actually owned electric vehicles. The gap is mainly due to barriers of cost, infrastructure and policies. Evidence based policies need to be addressed.

Keywords
Electric Vehicle, Adoption, People's Perception, SPSS, Regression Model, Log Frame Analysis

1. Introduction

Transportation systems is the base for sustainable development of any city and one major purpose is to shift from private vehicles to the public mode of transportation. The higher private cars result in traffic, congestion, overcrowding, cost and pollution increase and adversely affects the quality of life of the people in the city. With the introduction of ropeways in the 1960s and trolleybuses in the 1970s electricity as a source of transportation was introduced in Nepal. Until now, we have seen growths of EV integration in public transport at small scale through projects of e-rickshaws and SAFA tempos. In the recent budget plan of 2021/22 major policies and taxes, reforms are seen which would surely increase the market share of EVs in the coming decade.

Despite the development of electricity in transport sector worldwide, electric vehicles (EVs) are not the main mode of mobility in a country full of hydro power potential, Nepal which leads to huge import of petroleum products to fulfill the transport needs of the people. The failure of incorporating electricity in public transportation can be seen in trolley bus that failed due to organization management. With the flourishing market of traditional internal combustion engines (ICE) vehicles, now the EV is a new technology in which the user's factor and their perspective are not much known in the Nepalese scenario.

Transportation through EV will mitigate the environmental problems caused by ICE vehicles and help to reduce the import of gasoline products. The research aims to find perceptions, attitudes and behavioral intentions towards mass adoption of electric vehicles and identify advantages and barriers to consumer adoption. The other goals are to understand an emerging EV culture, review policy response to address challenges regarding adoption of EV, determine potential obstacles to EV adoption and influence of sustainability on EV purchase decision.

2. Literature Review

Urban mobility cultures include material and elements of a transport system as part of a specific socio-cultural setting, which consists of mobility-related discourses and travel patterns and built environment [1]. The objective dimension of urban mobility cultures consists of Urban form, transport infrastructure, and socio-economics. Urban form features are the 3 D's Density of the urban fabric, Diversity of land uses;, and Design of street or public transport networks [2], and they explain travel behavior. Transport infrastructure, Socio-demographic features are the structural factors persuading lifestyles and attitudes. The subjective dimension are obtained by mixing satisfaction and perception indicators; consists of lifestyle, attitude, perception, and behavior [2]. Symbols, self-identity, socio-economic and demographic characters are the prerequisite to develop the notion of lifestyles. Attitudes and preferences influence the perception of transport modes and infrastructure supply. The mix of the subjective dimension of perceptions and attitude with that of objective dimension of socio-economics and demographic variables gives a more comprehensive understanding of urban mobility cultures as a whole.

The Theoretical frameworks in consumer EV adoption research consists of the Theory of planned behavior which believes that people make decisions based on rational evaluations of consequences of decisions [3, 4]. Further Normative theories and environmental attitudes say EV adoption behavior to be pro-environmental behavior as based on individual interest in the environment and its protection. Symbols and lifestyles expressed as an individual's self-identity are important attributes in consumer adoption of EVs. Similarly, self-identity defines our attitude towards different attributes of EVs like price, style, performance, and energy efficiency. There are five factors of the Diffusion of Innovation model that influence the adoption decision: relative advantage, compatibility, complexity, trialability, and observability [5]. Moons and De Pelsmacker have defined three emotional processing levels: visceral, (style, design, and size) behavioral (using and experiencing driving EVs), and reflective (symbols, self-image, and identity) to determine consumers' emotions to adopt EVs [6].

Consumer EV adoption behavior is further explained on basis of consumer intention to adopt and their actual adoption behavior. The five behavior factors are connected to the five theoretical frameworks [3].

A. A behavior influenced by attitudinal factors If policies regarding fuel price, environmental regulations, and incentives fail to reach the public, it will affect the adoption of EVs by the users. Also, the user attitude towards technology, utility, and features compared to ICE vehicles will affect consumer adoption of EVs.

B. A pro-environmental behavior A behavior based on individual interest towards the environment and its protection and the motivating factor of users to buy EVs.

C. An innovation adoption behavior With the rapid advancement of technologies, consumers can create resistance in the adoption of EVs as they might feel that something new and better will come to market very soon thus making the current adoption obsolete.

D. A symbolic behavior EVs as innovation must be symbolically related to the users and they must be able to self-express their identity through them.

E. An emotional behavior The emotional attributes of pleasantness and joy, excitement, pride shows positive perceptions of attributes of EVs leading to more positive emotions which in turn positively influence the intention to adopt EVs [7].

3. Research Framework

The different parameters based on the 3 pillars of sustainability are shown in Figure 1.

These parameters are then used to build a research framework based on urban mobility culture and consumer adoption attitude and behavior.

Socio-demographics: Gender, Age, Education Level, Income Level, Occupation and Size of family.

Human Travel Behavior: Average Distance Traveled daily, when users leave and come home from activities, Mode of transportation/commute preferred and Purpose of travel (work/ study/ Recreation/ Socializing/ others).

EV experience: If users own EV, Type of EV owned, Charging accessibility,Safety, Satisfaction and Usefulness.

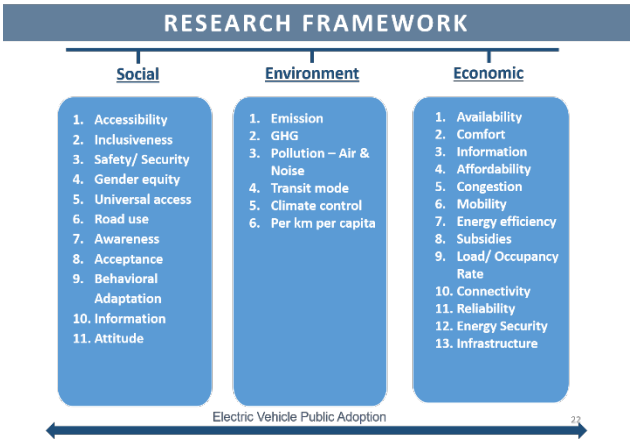

Figure 1: Sustainability Indicators

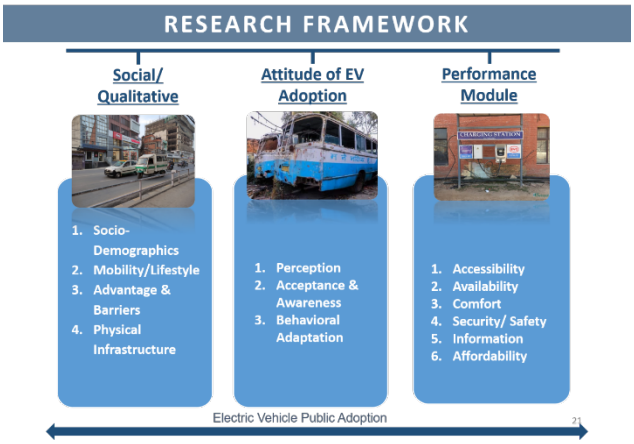

Figure 2: Research Framework

Behavior/ Knowledge/ Awareness: Knowledge and Interest about EV, Sustainable choice than ICE, Reasons to buy EV, Enjoyment and Travel Demand, Advantage/ Barriers.

Public Transportation: Availability (Frequency, Waiting Time), Affordability, Accessibility (Overloading, Night, Distance), Behavior, Safety, Security and Comfort.

Attitude: Sustainable Purchase behavior, future interest in EV, Preference to ICE, Behavior towards climate change, social pressure, social commitment to reduce petrol import.

4. Methodology

The research follows Pragmatism Paradigm, Exploratory and Descriptive Research Design and both Inductive, Deductive Approach. It includes both qualitative and quantitative data analysis for social science. The questionnaire was designed based on the research model, which consisted of four parts.

Part I was related to the socio-demographic variables, Part II gathered basic information about travel behavior, average daily travel distance. Part III measured the Advantage and Barriers of EVs. Part IV covered questions about the factors affecting the consumers' attitude and behavior of EVs. All the factors are measured by multiple items on a 5-point Likert scale that ranges from 1= Strongly Disagree to 5= Strongly Agree.

The sample frame is Kathmandu valley Population 2,517,023 [8]. The Target group were (15-64) years population i.e., 58.2% of the total population. A sample size of 251 was obtained with 95% confidence level and 6% margin of error. The sampling method of Convenience sampling was used. The questionnaire were distributed online through Google forms and for data analysis, Regression Analysis and Correlation were employed to investigate the differences in perceptions and attitudes using SPSS version 26.

5. Study Area

The topography of the Kathmandu is bowl-shaped which limits the movement of the wind and air pollutants are confined thus vehicular emissions are trapped inside which gives air pollution a major threat to the valley.

As Nepal is a landlocked country with difficult geographical elevations, road transport dominates all modes of transportation. According to MOF [9], 84% of the total registered vehicle in Nepal were motorcycles, which fulfilled 19% of total passenger travel demand and consumed 17% of the gasoline import. The average annual growth rate of 14% for the registration of vehicles. 36% of the total vehicles in Nepal were in Kathmandu valley [10].

As the study by DOTM [10] 97% of registered vehicles were private and only 3% were public in Kathmandu valley in 2017. 'Based on registered vehicles, there are only 10 public vehicles per 1000 persons, 47 private vehicles per 1000 persons and 274 motorcycles per 1000 persons in Kathmandu valley in 2017' [8, 10]. The number of EVs in the country including private and public vehicles, reached 21000 in 2017, according to the Electric Vehicle Association of Nepal (EVAN) [11].

6. Perception Analysis

6.1 Socio-Demographic Profile

From the survey of 251 respondents, the majority of the respondent's 54.6% were males and 45.4% were females. The distribution of income are shown in Table 1.

Table 1: Socio-Demographics - Family Income

Income	Frequency	Percent
Under 25,000	20	8.0
25,000–39,999	38	15.1
40,000–49,999	45	17.9
50,000–74,999	66	26.3
75,000–99,999	36	14.3
over 100,000	46	18.3
Total	251	100.0

16.3%, 51%, 22.7% and 10% of total respondents were in the age group 15-24, 25-35 36-50 and 51 above years respectively. 0.8%, 15.9%, 45%, 35.9% and 2.4% were Elementary, High School level, Graduate, master's level and PhD levels respectively.

51%, 4.8%, 32.7% and 11.5% respondents were Engineer/Architects, homemaker, students, and others. Also, 10.4%, 48.2%, 23.1% and 18.3% had 3, 4, 5 and more than 6 family members.

6.2 Human Travel Behavior

Table 2: Average Distance Travelled daily

Distance	Frequency	Percentage
Less than 10 km	136	54.2
11-20 km	63	25.1
21–30 km	30	12.0
31–40 km	20	8.0
41–50 km	2	0.8
Total	**251**	**100.0**

18.3%, 25.5%, 31.5%, 15.1% and 9.6% left for their daily schedule before 8am, 8-9am, 9-10am, 10-11am and after 11am. Also, 15.1%, 21.5%, 32.3%, 23.9% and 7.2% returned home before 4pm, 4-5pm, 5-6pm, 6-7pm and after 7pm respectively.

People preferred their vehicles (49.8%) followed by Walking (26.3%) and public buses (12.7%) as their first choice of commute. Adversely People preferred Public Transport (29.5%) followed by Walking (26.7%) and Own Vehicle (19.1%) as their second choice of commute and Public Transport (33.9%) followed by Walking (29.5%) and Own Vehicle (19.1%) as their third choice of commute. This shows we need to adopt measures such that Public Transport can be turned into the first choice of commute.

Table 3: Gender vs Purpose

GENDER / PURPOSE		Work	Study	Recreation	Socializing
Female	Mean	2.79	2.56	3.22	3.27
	N	104	108	98	102
	Std. Deviation	1.964	1.747	1.256	1.244
Male	Mean	2.48	2.65	2.94	2.59
	N	127	113	107	115
	Std. Deviation	1.872	1.684	1.338	1.107
Total	Mean	2.62	2.61	3.08	2.91
	N	231	221	205	217
	Std. Deviation	1.916	1.712	1.304	1.220

With cross referencing gender with the purpose of travel, mostly females traveled for recreation, socializing followed by work and study. The males, traveled for recreation and study followed by socializing and work as is shown in Table 3.

6.3 Attitude of Electric Vehicles

Analysis showed, mostly female (86%) aged 25- 35 (75%), Engineer/ Architects (75%) with a graduate degree (72%),income group 50000-74999 (79%) and traveling less than 10km (80%) showed positive sustainable purchase behavior as shown in Figure 3. Although people have a positive affinity for sustainability (73.7%) while using vehicles, very few (8%), actually own EVs from the survey. The gap is mainly due to barriers of cost, infrastructure, and policies.

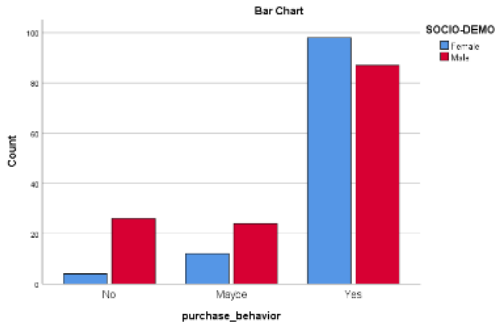

Figure 3: Sustainability Purchase behavior on the basis of gender

The survey showed Environmental Concerns (55%) followed by the Price of electricity vs gasoline (30.7%) and lastly Tax breaks and net price of the vehicle (20%) as the major reasons for people to switch to EVs. The

other reasons being Advance Technology, Charging Facilities, Reduce dependence on Petroleum, Safety features of the vehicle, societal status, and vehicle performance.

Table 4: Reason for buying EV

Reason for buying EV	First Reason	Second Reason	Third Reason
Advanced technology	3.6	12.7	6.4
Available charging facilities	5.6	12.7	7.2
Environmental concerns	55.0	13.5	19.5
Price of electricity vs. gasoline	11.2	30.7	22.3
Reduce dependence on petroleum	6.4	9.6	9.6
Safety features of vehicle	4.0	4.8	3.2
Status of EV ownership	1.6	1.6	4.0
Tax breaks	8.8	10.4	20.7
Vehicle performance	2.4	2.4	6.4
None	1.6	1.6	0.8
Total	**100.0**	**100.0**	**100.0**

The advantages of EV ranked as Decrease Petroleum Import, GHG Reduction, less maintenance, Comfort and Looks/ Style. This shows people being conscious about the economy and also pro-environmental behavior. Similarly, the barriers ranked as Charging Infrastructure, Battery Range, Cost, Reliability, Safety, and Design.

6.4 Public Transportation (PT)Behavior

Survey shows, Sajha Bus (37.8%) followed by Safa Tempo (33.5%) and Public Bus (12.7%) were the first mode of public transport. Sajha Bus (23.9%), Sundar Yatayat (20.7%), Public Bus (20.7%) wre the second mode and Mini Bus (30.7%), Sajha Bus (18.3%), Public Bus (18.3 %) were the third mode of preferred public transport. Females have more affinity towards Safa Tempo but less towards Sundar Yatayat. Also, females show more affinity towards using Public Transport.

Availability (39%) as first reason; Accessibility (48.2%) as second and affordability (32.3%) as third reason are the driving factors to use public transport. The other reasons being sustainability, Comfort and Safety. To make sustainable public transport and switch to EV as a public transport medium, these 3 factors need to be developed and revised for mass implementation.

Table 5: Driving Factors to use public Transport

Driving Factors	First Reason	Second Reason	Third Reason
Accessibility	15.9	48.2	20.7
Affordability	31.1	18.3	32.3
Availability	39.0	15.9	24.7
Comfort	4.8	1.6	2.4
Others	4.0	5.6	7.2
Safety/ Security	2.8	5.6	4.8
Sustainability	2.4	4.8	8.0
Total	**100.0**	**100.0**	**100.0**

The public transportation concerns ranked as Overcrowding, Occupancy Rate, Traffic, Poor Road Condition, Waiting Time, Frequency of vehicles in peak and non-peak hours, Safety, Public Toilets, Absence of Street lights and Cost. The behavioral concerns ranked as Safety; Rash Driving; Sexual Harassment; Misbehavior by passengers, drivers, conductors and Drunkards and others. The overall barriers of public transportation are Cleanliness and Maintenance, Uncomfortable for women, Uncomfortable Seats, Night Safety, Accessibility at night, Reliability, Routes, and Transit Points and Cost.

The survey showed 78.5% find PT accessible during day time. Sajha Bus (33.5%) has good frequency of buses per population followed by public bus (28.7%) and Sundar Yatayat (17.9%). Currently most occupancy is met by Public Bus (50.6%); Safa Tempo (16.7%) and Sundar Yatayat (12%). Similar trends are seen in Passenger Ratio and vehicle frequency. This is due to less options in terms of electric public transport than traditional ICE vehicles. In terms of waiting time none (23.1%) available public transport meet the needs of the people followed by Sundar Yatayat (21.9%), Public Bus (21.5%), Safa Tempo (20.7%) and others (12.7%). For transit point Sundar Yatayat has viable positive points with (30.7%) followed by none (23.9%), Public Bus, Safa Tempo and others. People believed Safa Tempo (37.8%), Sundar Yatayat (21.5%) followed by none, and Public Bus are Sustainable. This shows people being somewhat aware about the benefits of public transport to environment.

6.5 EV Behavior

Survey showed most people 53%, 47%, 10%, 24% and 40% people from the survey show most positive attitude towards EV adoption behavior on the basis

of environment, attitudinal, symbolic, emotional and innovation adoption behavior. 1 is the most unlikely and 5 is the most likely positive behavior of adoption behavior of EV.

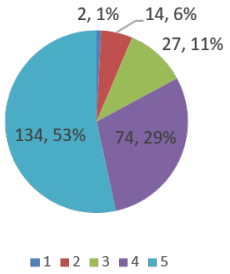

Figure 4: Pro Environment Behavior

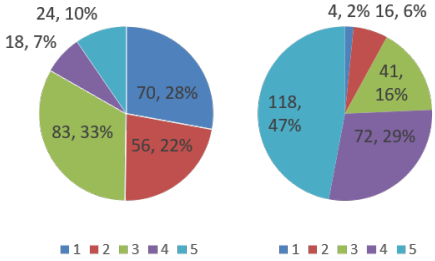

Figure 5: Symbolic Behavior and A behavior influenced by attitudinal factors

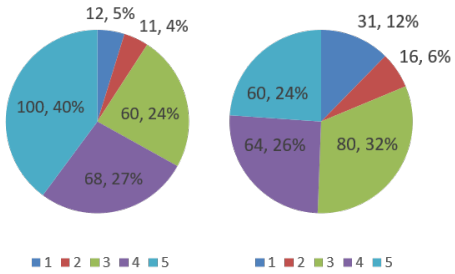

Figure 6: An innovation adoption behavior and An emotional behavior

6.6 Regression Analysis:

Linear regression identifies relationship between the dependent variable (Attitude, Advantage, Barriers , Experience towards EV) and independent variables of socio-demographics. In this case, regression analysis provides information about the scope and nature of the relationship to make predictions.

6.6.1 Regression analysis of Advantage and Socio-demographic profiles:

a. Predictors:

Family members, Age, Gender, Income Level, Occupation, and Education.

Table 6: R-square table

R	R Square	Adjusted R Square	Std. Error of the Estimate
.398a	.159	.127	.95172

Table 6 shows that value of R Square is 0.127 which means 12.7% variation in Advantage is explained by Socio-demographic profiles.

b. Regression ANOVA Table:

Table 7: Regression analysis of Advantage and Socio-demographic profiles

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Remarks
	B	Std. Error	Beta			
(Constant)	3.071	.502		6.114	.000	
Gender	-.612	.127	-.300	-4.83	.000	Model is significant
Age	.079	.078	.066	1.007	.315	Model is insignificant
Occcupation	-.010	.056	-.012	-.182	.856	Model is insignificant
Education	.051	.055	.060	.930	.353	Model is insignificant
Family member	-.066	.068	-.059	-.980	.328	Model is insignificant
Income	-.004	.041	-.007	-.108	.914	Model is insignificant

c. Dependent Variable: Advantage

Table 7 shows that the beta coefficients for Age and Education are positive with Advantage thus have positive impact with Advantage. But, the beta coefficients for Gender, Education, Occupation and Family members are negative with Advantage thus these have no effects on advantage. The result also shows that the beta coefficients for Gender is significant at one percent level and beta coefficients for Age, Education, Occupation, Income and Family Members variables are not significant at one percent level.

From the Regression ANOVA table, it can be inferred that the independent variables Gender, Age, Education, Income, Occupation and Family Members have tendency to predict the relationship with dependent variables of Purpose Advantage, Barriers, EV experience, Attitude and Behavior of EV which are summarized in Table 8.

Table 8: Regression Summary of Various Variables with Socio-Demographics

Dependent variable	Variation %	Significant models
Advantage	12.7%	Gender, distance traveled & leaving for work
Barriers	5.9%	Gender, distance traveled & leaving for work
Purpose	8.5%	Age & leaving for work
EV experience	67.3%	Age, Occupation, Education, Family Member, leaving for work & returning home.
Attitude EV	4.2%	Education & Income
Behavior EV	9.4%	Family Member, Income & leaving for work
PT Behavior	4.5%	Occupation & leaving for work
PT Concern	8.1%	Age, Occupation & leaving for work
PT infrastructure	10.7%	Age
PT behavioral concern	14%	Gender, Age, Family Member, & leaving for work

6.7 Correlation Analysis

Correlation measures the strength of a relationship between two variables. A high correlation shows variables have strong relationship and low correlation shows that the variables are hardly related. When the correlation is 0, there is no relationship between them; when the correlation is positive, there exists positive relationship ; when the correlation is negative, there exists negative relationship between the two variables.

Table 9 presents correlation coefficient between the variables used in study based on 251 observations. The dependent and independent variables are Advantage, Barriers, and purpose.

Table 10 also shows that Advantage, Barriers, and purpose at the 2-tailed significance value are significant as their value 0.001 less than 0.01. It indicates that better Advantage and experience towards the EV stimulates the increase Adoption. Advantage is positively and Behavior is negatively correlated with purpose and barriers of EV adoption. Similarly, PT infrastructure are positively correlated with advantage of EV and purpose of travel; and negatively correlated with barriers of EV.

**. Correlation is significant at the 0.01 level (2-tailed).

Table 9: Correlation between advantage, Barrier, purpose, EV experience, attitude, behavior, Public Transportation Behavior:

		Advantage	Barriers	Purpose
Advantage	Pearson Correlation	1	-.502**	.240**
	Sig. (2-tailed)		.000	0.000
Concern	Pearson Correlation	-.502**	1	-.087
	Sig. (2-tailed)	.000		.169
Purpose	Pearson Correlation	.240**	-.087	1
	Sig. (2-tailed)	.000	.169	
	N	249	249	249

Table 10: Pearson Correlation of various variables

	Advantage	Barriers	Purpose
Advantage	1	-.502**	.240**
EV experience	-.061	.117	.425*
EV behavior	.110	-.180**	-.178**
PT infrastructure	.297**	-.365**	.186**
PT concern	.292**	-.343**	.250**
PT concern behavioral	.337**	-.301**	.165**

7. Qualitative Analysis- Log Frame Matrix

Log Frame Matrix (LFM) is a strategic planning and project management tool for diagnosing and solving problems in planning and managing solutions. It outlines what the project is trying to do, how it makes key assumptions, and outputs and outcomes are evaluated.

7.1 Stakeholder Analysis

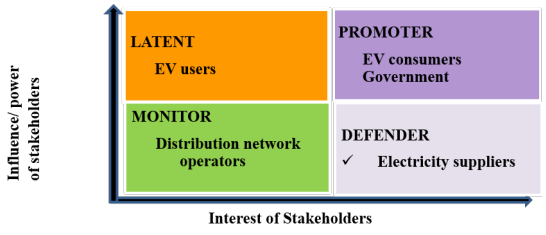

Figure 7: Stakeholder Mapping

The major stakeholders are the SAFA Tempo owners, and the EVs manufacturers, Clean Locomotive Entrepreneur Association of Nepal, Nepal Electric Vehicle Charging Association, MoPIT, DOTM, EVAN, transportation stakeholders electricity

distributors, and experts.

7.2 Problem Analysis

The problem analysis explains where are we now. The major problem is the attitudinal acceptance of EV:

Operational unsustainability - Lack of proper repair and maintenance center, Lack of body to advocate use of EVs, Lack of workshop/ awareness.

Weak EV charging infrastructure - No sufficient charging station, Gap in Research and Development, huge no of ICE vehicles, High cost of 4-wheeler EVs.

Lack of tax incentives and policies - Random Government decision, Lack of investment in EV sector, Weak planning and budgeting, Incentives not favorable for private sector investment, Lack of evidence-based policies.

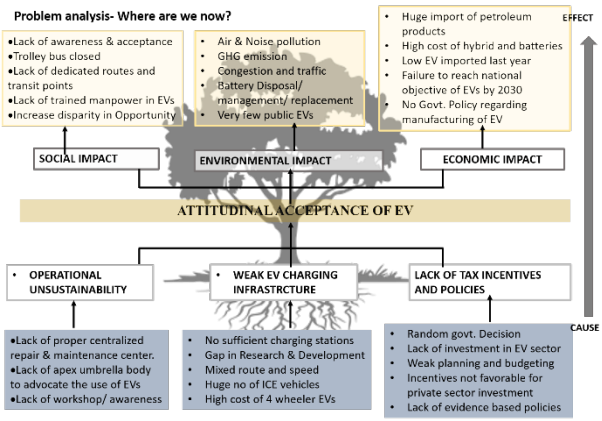

Figure 8: Problem Analysis

The **social impact** caused by these effects are Lack of awareness and acceptance, Trolley bus closed, Lack of dedicated routes and transit points, Lack of trained manpower in EVs, Increase disparity in Opportunity.

The **environmental impact** is - Air and Noise pollution, GHG emission, Congestion and traffic, Battery Disposal/ management/ replacement, very few public EVs.

The **economic impact** is - huge import of petroleum products, High cost of hybrid and batteries, Low EV imported last year, Failure to reach national objective of EVs by 2030, No Government Policy regarding manufacturing of EV.

7.3 Objective Analysis

Similarly, in order to change the scenario around and analyses where we want to reach by the end of 2031 according to national policies the means are operational sustainability, development of charging infrastructure and proper tax incentives and policies. Shift to public share of EV and provide Tax benefit to 4 wheeler.

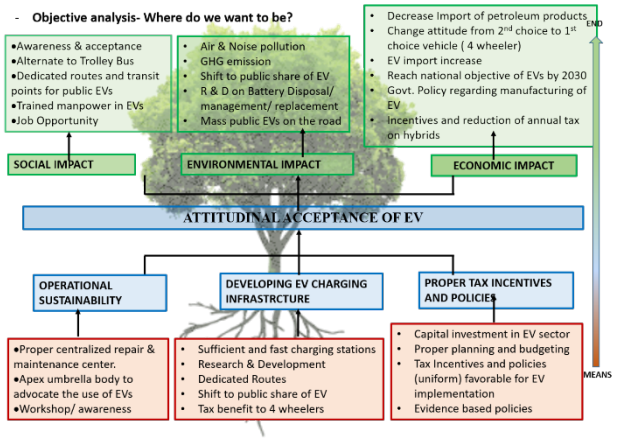

Figure 9: Objective Analysis

7.4 Alternative Analysis

Alternative 1: Shift to public mode of EVs and making public transportation more accessible

This can be achieved by Operational Sustainability, Dedicated Routes and developed transit points for public EVs, Fast charging stations for public EVs and Modal shift from private to public mode of Transportation.

Alternative 2: Trolley Bus Redevelopment

Trolley buses were introduced in Kathmandu in 1975.

It suffered faults, theft of overhead wires and lack of investment. We need to learn from this project is not only to have technically advanced buses but also have good management and operatinalization system.

The advantage of bringing trolley bus is it reduces cost and energy consumption of electric public transport by optimizing infrastructure and no battery disposal problem. It is more environment friendly than BEVs and also has emotional attachment for people. It can be achieved by Dedicated Routes and developed transit points for Trolley Bus.

Also, for the redevelopment, overhead wire are expensive and they limit the bus route flexibility. There are better EV solutions with more mobile and attractive vehicles.

With Trolley Bus, there is zero infrastructure and reconstruction all over from scratch.

Project elements	Indicators	Means of verification	Assumption
Goals Perception, attitudes and behavioral intentions towards mass adoption of EV, change attitudinal acceptance of users; Shift to public share of EV;	• People Interest and behavior change for mass implementation • Shift to public share of EV • EV import increase	• Air Quality Index • Noise pollution • GHG emission • More people use public mode • Awareness & acceptance	• Pollution will decrease • Decrease Import of petroleum products • Mass public EVs on the road • Change attitude from 2nd choice to 1st choice vehicle (4 wheeler)
Purpose influence of sustainability on EV purchase decision, determine potential socio-technical obstacles to EV adoption; advantages and barriers to consumer adoption of EVs;	• Interest and involvement of concerned bodies • Popularity of EV • Increase in number EV buyers	• Advertisement • Increase number of buyers	• people misconception will be cleared. • people have positive attitude towards EV and adoption will be easy,
Output • review policy responses to address consumer view, behavior, and attitude towards the adoption of EVs and their resulting challenges. • empirical evidence of trends and conditions of electric transport usage, differentiated by different travel modes	• Govt. Policy regarding manufacturing of EV • Proper planning and budgeting • Tax Incentives and policies (uniform) favorable for EV implementation • Evidence based policies	Reach national objective of EVs by 2030	• Charging Stations • Subsidies • Incentives and reduction of annual tax on hybrids
Activities • Proper centralized repair & maintenance center, Research & Development • Apex body to advocate use of EVs • Investment in EV sector Tax Incentives and policies (uniform) favorable for EV implementation	• R & D on Battery Disposal/ management/ replacement	• Alternate to Trolley Bus • Dedicated routes and transit points for public EVs	• Sufficient and fast charging stations • Research & Development • Shift to public share of EV
Input • Strict implementation of policies and providing incentives • Workshop/ awareness • Dedicated Routes, Funding, Proper Transit Points	• Evidence based policies • Capital investment in EV sector Tax Incentives • policies favorable for EV implementation	Reach national objective of EVs by 2030	•Trained manpower in EVs •Job Opportunity

Figure 10: Log Frame Matrix for people perception of EV

8. Review of policies

Government is planning to build 500 charging stations across country in the coming year. Also, the major policy is to completely replace ICE vehicles by EV vehicles in next 10 years i.e., by 2031. There is provision to grant fee land for EV manufacturers in the world to build their assembly station in Nepal. For public vehicles, 100 EV bus would be imported in the coming year in Nepal. For users who convert ICE to EV five years of renewal tax will be waived. The new taxation of two-wheelers is 10% Customs Duty, 0% Excise Duty, 13% VAT, and Rs. 10,000 RDT. The change of tax on 4 wheelers in 020 and 021 are shown in Table 11.

Table 11: Tax on four wheelers

Power	Excise Duty		Custom Duty	
	020/021	**021/022**	020/021	**021/022**
50 – 100 kW	40%	**0%**	80%	**10%**
100-150 kW	50%			**15%**
150-200 kW	60%			
200-300 kW	70%			**30%**
300 kW above	80%			**40%**

9. Recommendation

The recommendations includes different import taxes for ICE versus EVs based on their environmental performance. In short term: guidelines for vehicle conversion; The reliability of electricity supply must be improved. The green license plates on EVs, free parking at public places can enhance adoption. Campaign and Advertising to induce the emotional appeal; Awareness about EVs performance, environmental effects and technologies development.

In the medium term: Affordable and accessible chargers; EV design equally accessible to all users; Purchase subsidies for EV, tightening of fuel economy and emission standards; Data sharing protocol for air quality data; Building codes for new construction to include charging points; Taxis can be switched to EVs.

In the long term: Investment to update the infrastructure. Identifying future needs to determine network size at market adoption phase of EVs, Creation of a stakeholder map to identify actors willing to collaborate on the adoption of EVs.

10. Conclusion

The consumer feelings help to design rules, policies which can overcome the barriers in the adoption of EVs. With Kathmandu people average daily commute under 40 kilometers (within the range of most EVs), EVs can be a practical alternative to ICE vehicles, especially in public transport.

Since electric public service is at a very initial stage, factors must be considered beforehand such that the problem faced by users are heard and the solutions implemented at proper time. If not, the popularity of public mobility would go down and the problem of congestion and pollution would keep on increasing which at last would affect the quality of life of people in Kathmandu and cities with similar problems in traffic and mobility.

For the future of electric vehicles, it is still in an early stage in Nepal. With the advancement of EV technology, the transition of EV will occur more gradually. And this shift in response to climate change and energy dependency is now mandatory. Therefore, further research on EV technology and consumer behavior should focus on innovation and market diffusion.

The study was based mainly on online survey. The accuracy of the study depends on the quality of response from respondents. Because EVs are still in an early market phase, potential consumers surveys face the problem of valid expression of attitudes and intentions regarding new, rather unfamiliar vehicle types.

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