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Conversion of Petrol Driven Vehicles into Electric: Detail case assessment of Nepal

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Abstract
The broad goal of this research is to explore the economic, environmental, and socio-cultural aspects of sustainable development due to the conversion of petrol-driven vehicle into electric. Study has been started by exploring the vehicle conversion history and further study flows with the identification of conversion cases in present scenario of Nepal. The paper focuses on the cost-benefit analysis of vehicle conversion in terms of initial investment, conversion cost operational cost and maintenance cost. The paper also seeks to quantify the reduction of carbon footprint which results from conversion and also tries to figure out the socio-cultural perception towards conversion. Five different cases of vehicle conversion in Nepal are taken and a broad study has been done. During the study, many research gaps and challenges were found regarding conversion. However, the use of electric vehicles is just an emerging mode in Nepal and thus, the conversion cases are so few in number. The study employs a mixed methodology that fits into a sequential exploratory design. Interviews, questionnaires, and participant observation were used to collect the data.

Keywords
Petrol driven vehicle, Vehicle Conversion, electric vehicle, plugin hybrid vehicle, Sustainable development

1. Introduction

When the subject is research on electric vehicle (EV), generality is made an association with new and revolutionary vehicles. However, low cost solutions using reliable off-the-shelf components can also be proposed.[1] This way, the conversion of Internal Combustion Engine (ICE) vehicles in to EVs is an attractive solution for the transitory period of coexistence. This process is called “electric vehicle conversion” [2, 3]. Vehicle conversion is mostly advantageous in the sense that it can help the environment by zero tail pipe emission controlling air pollution as well as reducing the trash of old conventional vehicles and reducing land pollution [4]. Beside these, reuse of old conventional vehicles, low maintenance of vehicle and the use of renewable energy are some other advantages of vehicle conversion [5]. Nepal has rich history in E-mobility. The first ropeway connecting Kathmandu to Dhorsing was introduced in 1922 and was later expanded to Hetauda with the total length of 42 km in 1964. Electric trolleybuses were introduced in Kathmandu Valley with support from the Chinese- government in 1975. These trolleybuses operated successfully along a 13 km route between Kathmandu and Bhaktapur until 2001 when it was shut down due to management problems. It opened again partially in 2003 but closed again in 2008. In Nepal vehicle conversion history began at 1992 A.D., a team of engineers led by Prof. Kiran Raj Joshi converted a Volkswagen car in Kathmandu, marking the beginning of vehicle conversion in Nepal (Prof. Joshi) and in 1995 A.D as fossil fueled seven tempos were converted in to electric and named as ‘Safa tempos’.The safa tempo project was first introduced by Global Resources Institute with the support of USAID. Today, there are over 700 Safa Tempos operating as public transportation in 28 different routes in the Kathmandu Valley.

The group of engineers who had pioneered the idea in 1992, along with other professionals and entrepreneurs constituted Nepal Electric Vehicle Industry (NEVI) in 1996, bought all the seven Safa Tempos and developed expertise for additional production of Safa Tempos. At the present there are other manufacturing companies,

which are Electric Vehicle Company (EVCO), Green Electric Vehicle Pvt. Limited (GREV) and so on.

After Safa tempos, there was long gap that the vehicles were not been converted due to absence of suitable policy regarding electric vehicles and vehicle conversion in Nepal. But recently some of vehicle conversion initiatives and practices have been started by some university students, private auto companies, engineers and mechanics in Nepal but conversion practices are still in the testing phase and not started commercially. Furthermore, some companies are recently registered in department of transport management in order to proceed the authorized conversion of vehicles in Nepal. The electrification of transport systems requires a change in the composition of the vehicle fleet towards higher shares of electric vehicles. A successful transition, however, depends on many factors of which some relate to purchase prices and vehicle features, while others relate to technology and charging infrastructure.

2. Research objectives

2.1 Specific Objective

To study social, environmental, economic and cultural aspects of sustainability that results from conversion of petrol driven vehicles in to electric one.

2.2 Main Objectives

- To study the history, present scenario and future possibilities of vehicle conversion in Nepal.
- To do the cost benefit analysis of vehicle conversion in terms of fuel cost and energy savage.
- To identify the socio-cultural perception and to quantify the reduction of carbon footprint due to conversion.

3. Research Gaps

People are attracted towards new electric vehicle but there has not been concern and research on conversion of vehicle. There is lack of development in country-based study of an increasing rate of EV users, and how the practice of EV conversion influences and contributes towards the Sustainable development of a country. There has not been Economic analysis between costs of establishing the petroleum-based transport sector to the cost of establishing the electricity-based transport sector and also there is absence of study on life cycle cost of converted vehicle. There is lack of development in detailed EV conversion focused plans and policies to drive up the EV sector and also there has not been study on development of infrastructures for easy conversion of vehicles in low price.

4. Research Question

To meet the objectives of this research, different questions are made for questionnaire survey which are mentioned below:

- Do Nepal has successful practice and implementation of electric vehicles?
- Why people are converting the vehicle and why aren't they?
- What are the policies governed by Nepal government regarding conversion?
- What is comparative cost benefit of the converted vehicle with new electric vehicle and petrol driven vehicles in terms of its life cycle cost?
- What can be the socio-cultural and environmental benefit due to conversion of vehicle?

5. Literature Review

The potential of EVs and its conversion can only be realized in a developing country with a focus on five factors:

1. Governing body's initiatives and laws.
2. Infrastructure development.
3. Investment by Government and EV related companies.
4. Availability of various EV options.
5. Running cost and convenience

5.1 Types of vehicle conversion

- Hybrid Electric Vehicles (HEVs). HEVs have a combination of internal combustion engine (ICE) with an electric propulsion system.
- Plug-in Hybrid Electric Vehicles (PHEVs). PHEVs also have a combination of ICE and electric propulsion systems. A PHEV stores energy from the electric power grid or through regenerative braking.
- Battery Electric Vehicles (BEVs). BEVs have larger battery packs to store more energy from the electric power grid for longer range. They have no backup gasoline engine. BEVs are also referred to by some as ”pure-electric vehicles” or ”all-electric vehicles” (AEVs).
- Fuel Cell Electric Vehicles (FCEVs). FCEVs refuel with hydrogen or biogas and use a fuel cell to produce electricity to propel the vehicle. FCEVs are also referred to as fuel-cell vehicles.

5.2 Vehicle Conversion policies In Nepal

On March 29th, 2022 Nepal Government issued a notice stating that now people can convert their petrol and diesel vehicle into electric or other alternative fuel vehicles. The Ministry of Physical Infrastructure and Transport has decided to give a three-year exemption for environment-friendly or energy-efficient modifications of the fuel system. Existing Vehicle and Transportation Management Act 2049 BS states that if the form of the vehicle in operation or any other change had to be changed, approval had to be obtained from the Transport Office. There was a legal provision to charge 50 percent of the registration fee for such approval. Due to this provision, fuel-powered vehicle could not be converted to electric in Nepal till now. However, the Ministry of Transport is yet to begin the registration process for centers for retrofitting old diesel and petrol vehicles with electric kits to convert them into electric.

5.3 Challenging factors on vehicle conversion

Monopoly market of EVs and conversion components cost, weak policy and finance, random electricity distribution and power availability, lack of charging stations and conversion infrastructures, political condition of the nation, unawareness and poor social perception towards conversion etc are some of the basic challenging factors for conversion of vehicles

6. Research Methodology

This research seeks to find out the history and present scenario of the vehicle conversion. And another motive of the research is to find out the environment, social, economic and cultural impacts resulted by vehicle conversion. Method starts with identification of different cases in Nepal. In this research 5 number of cases are taken as sample and detail case assessment has been done to find out the result in terms of various aspects of sustainable development and its’s goals.

The research strategy has been based on qualitative and quantitative case study. The data has been collected from literature, news articles, journals and through open questionnaire to the key persons.

The collected data has been processed and analyzed qualitatively and quantitatively. The quantitative data are more focused to find out the cost benefit and to quantify the reduced carbon emission and qualitative data are focused in people’s perception towards vehicle conversion in terms of socio-cultural values.

7. Case studies and data collection

Case 1 - Conversion of diesel and petrol powered Bikram tempos into electric i.e. Safa tempos

In 1993, Global Resource Institute (GRI) with the aid from US Asia Environment Partnership (ASAEP) and National Association of State Development Agencies (NASDA) was committed to research and develop EVs as a profitable and environment-friendly industry in the transportation sector. The idea was to convert Bikram and Bajaj (Diesel and Petrol) Tempos into Safa Tempos (Electric). Seven of the Safa Tempos were manufactured with the fund, were demonstrated and put into auction.

Case 2 - Maruti Suzuki Alto 800 converted by Mr. Saroj Praja at Gadyauli, Chitwan

In 2020 A.D, an Auto mechanic Mr. Saroj Praja converted a Maruti Suzuki alto 800 into hybrid vehicle (can be driven by both IC engine and by battery) and he himself is a user of that converted vehicle and still he is in testing phase as he is trying for further improvement in efficiency of converted vehicle. Mr. Saroj Praja is one of the young scientist of Nepal as he previously made paramotor and trex car and tested successfully.

Case 3 - Maruti Wagnor R converted by Thee-Go, Nepal

Thee-GO is a group of companies where sustainability is an integral part of their plan and woven into operations. They have taken initiatives for Zero Carbon Transportation by introducing Electric Vehicles in Cars, Bus, Micro-Bus, Pickup segment." Thee-Go, which has been selling electric vehicles and scooters, has recently converted an old fuel- powered Wagon-R into an electric vehicle. According to the company, the engine and fuel tank in the fuel vehicle have been completely removed and replaced with batteries and motors and still is in testing phase.

Case 4 - Maruti Gypsy King 413 model, The Land Rover Jeep and Nissan civilian bus Converted into electric by Nepal Army

Nepal Army has started to convert old vehicles running electric vehicles. The Nepali Army has begun to convert aging engine vehicles that rely on fossil fuel to electric vehicles. According to Rathi Gajendranath, technical assistant of the 'Electronics and Mechanical Engineering' (EME) section, the Nepali Army has begun this endeavor to give substance to the Nepal government's aim to reduce air pollution. So far, the army has converted three aging vehicles into electric vehicles. According to Khum Bahadur Kunwar, an EME branch technical officer, the engines, gear boxes, and radiators of all those vehicle were removed, and batteries, battery chargers, controllers, and meters were installed and turned into electric vehicle.

Case 5 - Petrol Driven Auto-rickshaws converted into hybrid vehicle at Dharan sub-metropolitan city.

"Venture Waste to energy" is a private company contracted by Dharan sub-municipality to turn waste into energy. This project was completed in june, 2022 and recently with the investment of Rs 250 million. "The waste is first segregated into organic, non-organic, recyclable, non- recyclable, reusable, and non-usable. Reusable waste is sold to the market and non-recyclable materials are sent to the landfill after being sanitized." "Organic waste is converted into energy through anaerobic digestion. Here, the pulp generated from waste is mixed with water and fed into a digester to be converted into gas over 21 days. They first store non-refined gas into balloons which is later converted into 90-92 percent methane. The purified gas is then compressed into cascades to fill autos and then gas is being provided to Auto by using CNG dispenser.

8. Findings

Safa tempos running in Kathmandu valley are powered by 72 volt battery which gives total ride range of 100-120 km in a full charge. It takes 7-8 hours to get fully charged and electricity costs around NRs.100 per full charge. There are 700 Safa tempos running inside Kathmandu valley. According to the Praksh Thapa, Vice president of the one of the Safa tempo organization, they are contibuting around 35 lakhs Nepali rupees annually to NEA as total of electric bill produced by 700 safa tempos while charging them. The cost of Safa tempo is around (8-10) lakhs Nepali rupees for lead acid battery powered vehicle and (13-15) lakhs Nepali rupees for Lithium ion battery powered vehicle. According to the Nepal free transport workers association, around 60 percent of Safa tempo drivers in Kathmandu valley are women. Vehicle converted by Mr. Saroj Praja was powered by 70 volt battery which can travel 120 km in a full charge. It cost electric bill of NRs. 100 for a full charge and battery takes 4-5 hrs to get fully charged. According to Mr. Saroj, total conversion cost of Alto 800 was 8 Lakhs rupees with 8 years of warranty on battery and initial cost of 12 years old Alto 800 before conversion was 3 lakhs. Assuming 50 km daily travel in average and accounting mileage of 20km/liter, this vehicle was emitting 2108 kg of CO2. And now after conversion the carbon emission is zero. In recent Market of Nepal, petrol powered new Maruti Suzuki Alto 800 costs 22 lakhs with mileage of 20km/liter. And new electric car having travel range of 150km/full charge costs around 25-30 lakhs.

Thee-Go Converted Wagnor-R which has battery capacity of (72-96) Volt which can power the vehicle up to 180 km in a full charge. Battery takes 4-5 hours to get fully charged and cost of electricity for a full charge is NRs.120 only. Valuated cost of Wagnor-R of age 10 years was 7 lakhs and conversion cost was around 12 lakhs.In recent Nepali market, the cost of petrol driven new Wagnor-R is 30 lakhs with mileage of 23km/liter. New EV which has travel range of 180 km in a full charge costs 30-35 lakhs.

The Army transformed a Maruti Gypsy King 413 model vehicle into an electric vehicle. They converted this vehicle in 350000 rupees excluding the cost of battery, solar system and some other spare parts. Lead

acid battery of total 76 volt is being used in the vehicle. It takes 8 hours to get fully charged and battery gives ride range of 50-60 km. It cost NRs. 120 to charge the battery fully. This car is being used as a'staff vehicle.' Engineer General Kunwar reported that a solar panel had been placed so that the battery could be charged even while the vehicle was running and parked. The old Land Rover Jeep powered from petrol is another vehicle that has been transformed from an engine vehicle to an electric vehicle. The army plans to use it as a "parade review vehicle" (a vehicle used during military parades). Mr. Karmacharya said that the project was successful when all these vehicles were subjected to a 'road running test'. However, these vehicles are yet to be certified for off-road use. He further stated that these army-made cars are perfectly safe for road use and will help minimize environmental pollution. However, he also informed that as a result of battery disposal, there may be problems in the environment, so the study is in progress.

Currently six auto rickshaws are supplied biofuel in Dharan. Auto uses 4 kg of cylindrical vessel to store CNG gas. 1 kg CNG provides ride range of 25-30 km in hilly road and 30-40 km in plain road. And 1 kg of CNG costs NRs. 130. In average one Auto rides 100 km per day at Dharan. The problem faced during conversion was the space to place the cylinder inside Auto. All of these Autos are made hybrid but due to some technical challeges they are unable to use that vechile as hybrid because they told that if they run auto by engine, vehicle is consuming double fuel than before. So, Dharan Sub-metropolitan city is planning for hiring some technicians and engineers from India to solve that problem after that they will be able to drive both from CNG and Internal combustion engine as per requirement.

9. Analysis and Discussion

9.1 Level of awareness on vehicle conversion

During the survey, few people were asked about that old vehicles can be converted into EV and used. It was found most of the people were aware about the new EV only as in the budget speech they decrease the TAX. Few people were not aware about it, they were surprised to hear the question that old vehicles can be converted. In addition to this some people said that they knew about conversion and were more concern.

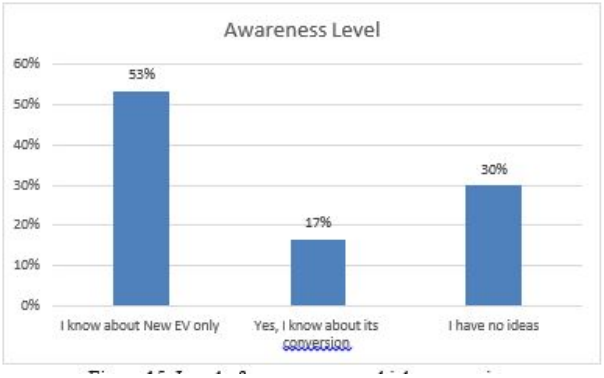

Figure 1: Level of awareness on vehicle conversion

9.2 Level of concern on vehicle conversion

During the field work, different stakeholders like researcher & engineers, mechanics/technicians, users/owners, auto trade companies, Ministry of Physical Infrastructure and Transport and public regarding their apprehension for the conversion of vehicles. It was found that people from the background of researcher and engineers were more concern, followed by users and owners, least concern were government sector followed by public sector.

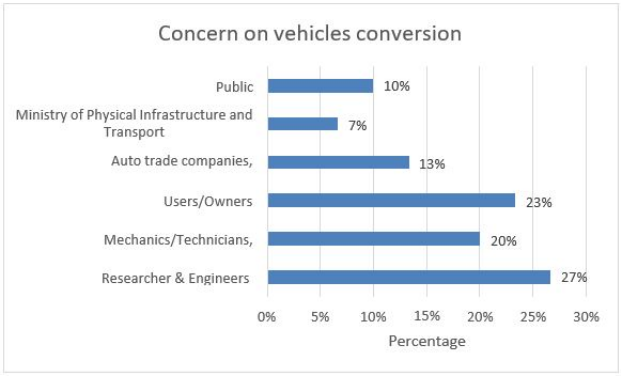

Figure 2: Level of concern on vehicle conversion

9.3 Why to convert old vehicle into EV and why conversion is not happening.

Engineers, technicians, users, owners, Automobile distributers, public and other related stakeholders were asked these questions and we offered some options as answers for those questions and finally we got some response from private sector and public sector regarding the conversion. Firstly, why people are converting vehicle has been discussed.

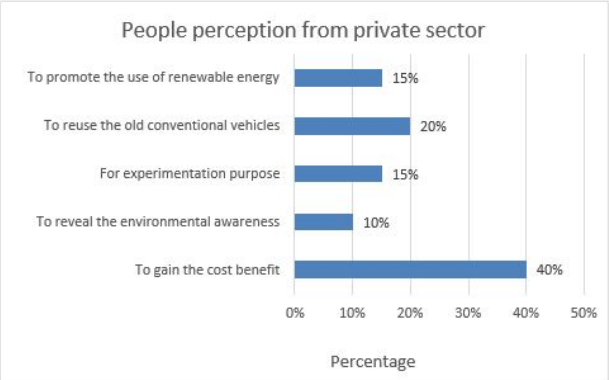

Figure 3: People Perception on Conversion from the point of view of private sector

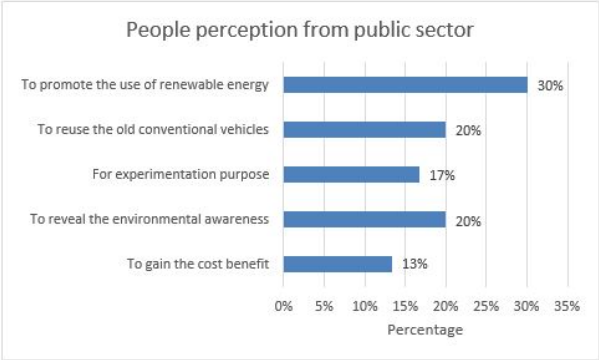

Figure 4: People perception on conservation from the point of view of public sector

And secondly while asking why vehicle conversion is not happening, different options were given and the result is;

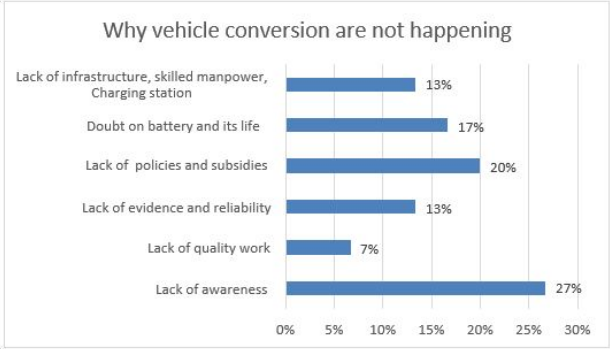

Figure 5: Why vehicle conversion is not happening

9.4 Types of vehicle that should be converted.

During the field work, to know the people perception on what types of vehicles need to be converted into EV was asked. Different option as were given to them and the result is shown in diagram.

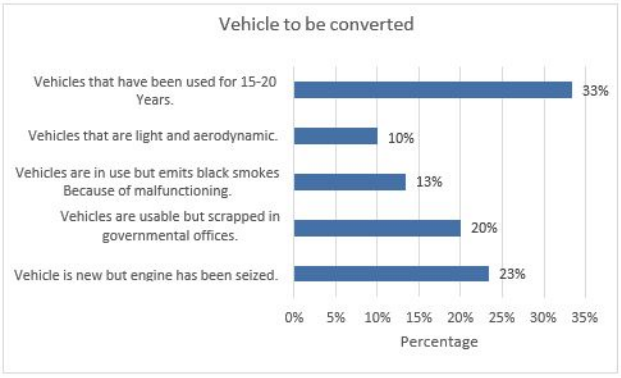

Figure 6: Type of Vehicle that should be converted (People Perception)

Most of the people though that the vehicles that has been used for 15-20 years must be converted as it creates lots of problem to the owner and doesn't work properly. They are themselves not sure when and where they require technician. Few people think vehicles which are new, but engine has been seized can be converted and it is best to do that. Its each part is usable just because of engine it is begin useless. In addition to this, few people think that vehicles are in use but emits black smokes because of malfunctioning followed by vehicles that are light and aerodynamic can be converted.

9.5 Which conversion do you prefer, conversion to purely electric or to plugin hybrid?

During the survey, people were asked to choose preferable conversion of vehicle into purely electric or into plugin hybrid vehicle and got some responses which is shown in figure.

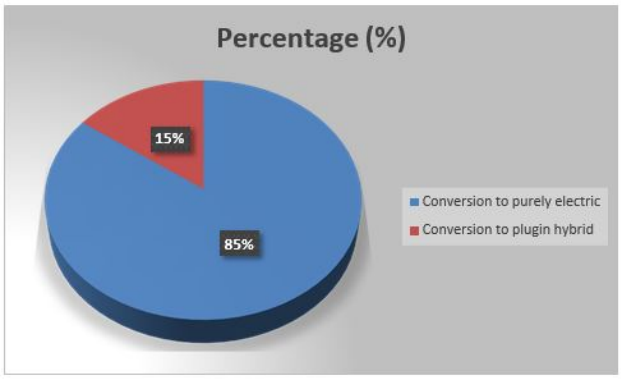

Figure 7: Preference of conversion

Why 15 % people have interest on plugin-hybrid electric rather than purely electric?

1. People are not interested to throw out the engine from their vehicle.

2. Conversion into purely electric may have risk in terms of travel range during long travel.

3. Converted EV may be difficult to run on the slopes and off roads as road networks in Nepal has covered Terai, hilly and mountain regions.

4. If electrical system malfunctions during travel, then system should run by internal combustion engine.

9.6 Comparative CO2 Emission

Assuming average drive per day as 50 km, CO2 emission has been calculated for petrol vehicle, purely electric vehicle and plugin hybrid vehicle. Here CO2 emission due to electricity production has not been considered because electricity production in Nepal is purely green. As per previous studies, it emits 2.31 kg of CO2 while burning 1 liter of petrol. On the basis of this, emission has been calculated and result is shown in the figure.

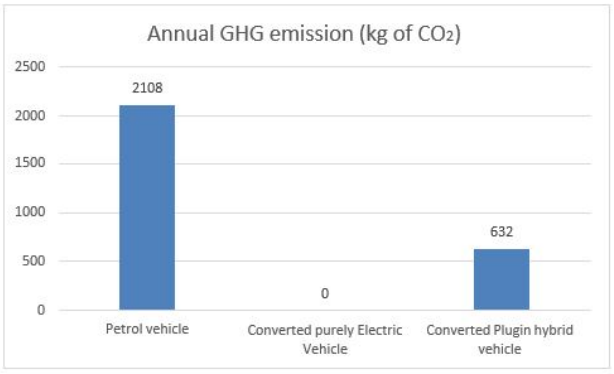

Figure 8: Annual GHG emission

As discussed in analysis part of case 2, while travelling 50 km daily in mileage 20km/liter it was emitting 2108 kg of CO2 annually. Here purely electric vehicle emits zero emission and for plugin hybrid vehicle let us assume 70 percent of ride has been done with electrical energy and rest of 30 percent from internal combustion engine. So, by accounting 30 percent of ride from internal combustion engine, plugin hybrid vehicle emits 632 kg of CO2 annually. This result indicates that the vehicle conversion can contribute to reduce the GHG emission.

9.7 Cost Benefit Analysis

In this research different cases were studied and on the basis of those cases, cost benefit analysis has been done in terms of initial investment cost, conversion cost, operation and maintenance cost of converted purely electric vehicle, plugin hybrid vehicle, new petrol driven vehicle and new electric vehicle having similar ride range.

9.7.1 Scenario for cost benefit analysis

For a comparative cost benefit analysis, vehicle conversion case 2 has been taken where Maruti Suzuki Alto 800 car has been converted into plugin hybrid electric vehicle. Here, average daily ride of that converted car has been taken as 50 km and mileage of new petrol alto has been taken 20 liter/km and for plugin hybrid 70 percent ride has been assumed purely electric and 30 percent ride has been assumed as engine vehicle.

9.7.2 Cost benefit in terms of initial investment

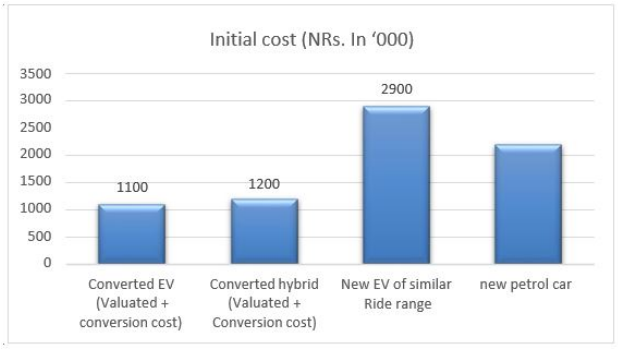

Figure 9: Initial Cost Comparison

Figure shows that initial cost of converted EV is much less than new EV of same range and slightly less than converted hybrid vehicle. Also here it has been seen that new EV is more costly than new petrol vehicle.

9.7.3 Cost benefit in terms of Operation cost

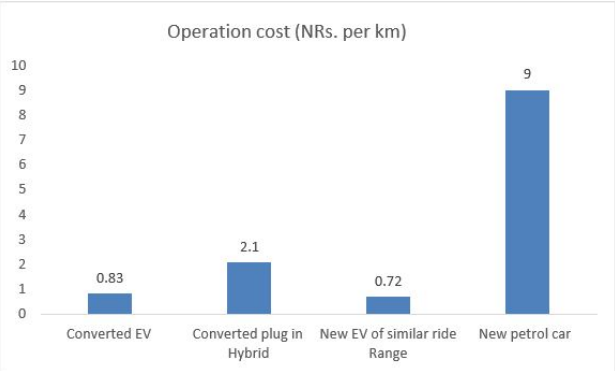

Figure 10: Operation Cost Comparison

Figure shows that operation cost of new EV is much less than that of new petrol car and plugin hybrid car and slightly less than converted purely electric vehicle.

9.7.4 Cost benefit in terms of Maintenance cost

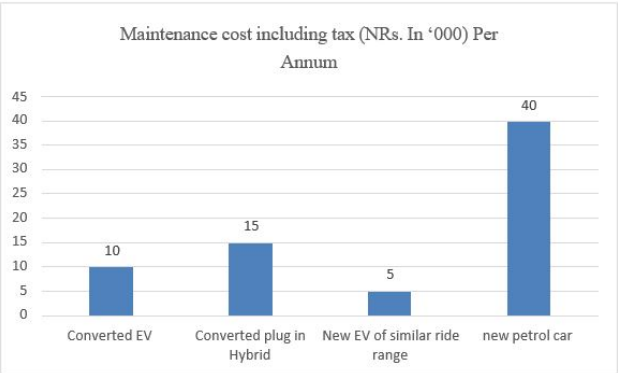

Figure 11: Maintenance Cost Comparison

9.8 Social and cultural impacts due to vehicle conversion

In these days educated people are interested in electric vehicle due to different benefits. But most of the people are not aware about conversion of vehicle. So, Study of Social, and cultural perception towards conversion of vehicle is most important. Converted electric vehicle are smooth without noise and vibration which contributes to creating peaceful environment in society. Vehicle conversion saves the economy of the society and nation. Firstly, they save money on petroleum fuel cost which is increasing day by day. And secondly, they save their economy by not purchasing the new EV but converting and using the existing or old vehicle in cheap price. Vehicle conversion will create job opportunities and entrepreneurship. As we found that there is 60 percent women driver who drives safa tempos are in Kathmandu valley. This is positive aspect that women are empowered due to conversion of petrol driven tempos into safa tempos. Electric vehicle also creates clean environment which is directly related to the good human health and balanced ecosystem in nature. From the research, we came to know that running electric vehicles may contribute to some of the cultural aspects of our society. During survey, we asked to the different people regarding cultural benefits due to electric vehicle and vehicle conversion and we got interesting answers from them. Cultural heritages like Temples, churches, Masjids, Guthis etc can have peaceful environment and fresh air to inhale by people if the vehicles are electrified. Usually, meditation centers and Gumbas are disturbed due to noise pollution from engines vehicles but if vehicle are electrified or converted, then there would be less chances of disturbance. Many vehicles are used inside National parks for different purpose like Jungle safari by tourists and for jungle inspection by officials and rangers. At that time animals get scared and disturbed due to sound of engine vehicles. So conversion of those safari vehicles into electric can reduce the disturbance for animals.

9.9 Barriers found for conversion of vehicles in Nepal

9.9.1 Technical Barriers

1. Lack of skillful manpower and workshop for conversion and maintenance.
2. Lack of infrastructure and charging stations.
3. Limited battery life
4. Lack of conversion kits and domestic industries.
5. Lack of evidence on reliability and performance of converted vehicles.

9.9.2 Social Barriers

1. Lack of knowledge on electric vehicle and vehicle conversion.
2. Lack of environmental awareness.
3. Lack of positive perception towards conversion of EV

9.9.3 Economic Barriers

1. Higher Conversion cost
2. Expensive conversion components (motor, battery, controller etc)
3. Battery disposal and replacement cost
4. Higher electricity price for charging.

9.9.4 Strategic policy Barriers

1. Lack of long term policy, planning and goals.
2. Absence of annual tax exemption for long term.
3. Absence of subsidies and incentives.

10. Recommendation

Going through case studies and literature review during the research, several barriers and research gaps have been found. Some suggestion has to be made to fulfill the limitations on vehicle conversion. The vehicle conversion is advantageous by different ways. So, this should be promoted. The most important thing is firstly the public awareness should be given about electric vehicle and vehicle conversion. The awareness should be provided to people by insuring them in terms of economic, environmental, and socio-cultural benefits due to vehicle conversion. Long term policies, subsidies and tax-free essentials should be provided to encourage people on vehicle conversion. Conversion infrastructures and testing protocols should be standardized. Conversion components cost should be made genuine, and that cost should be inspected by a certified authorization. Lithium ion batteries are suggested to use rather than lead acid batteries. The vehicle which has light body and good aerodynamics are suggested to be converted. Electrical distribution system should be smooth in every part of the nation so that charging stations can be installed in all suitable locations. Federal and provincial governments should make scientific target for the vehicle conversion and its regular inspection. Local manufacturing, assembling, and converting into EV should be promoted. Several training should be provided to the Engineers, technicians and researchers including women and they should be certified as skillful manpower for vehicle conversion.

During research it has been found that the main problem on vehicle conversion is ‘lack of proper policies and strategies. Here we have concluded some suggestions on the basis of some international practices related to the conversion which are listed below:

10.1 Strong target and Strategy is primary need

Stimulate growth in the electric vehicle market by introducing targets, mandates and incentives for vehicle conversion is basic need in Nepal.

10.2 Need of consistent and long term policy

The Ministry of Physical Infrastructure and Transport has decided to give a three-year exemption for environment-friendly or energy-efficient modifications of the fuel system. But three year is not a long term period. This policy should be improved and prolonged.

10.3 Ambitious and realistic targets should be in priority

Nepal has also declared some targets, but these are either unrealistic or are not ambitious enough. And there is no any ambitious target in vehicle conversion. More analysis and stakeholder consultations need to be done and these targets revised accordingly.

10.4 Political commitment

It takes ownership, dedication, and leadership to put policies into practice. In Norway, political parties have agreed to a climate strategy, while in nations like China and India, the highest levels of government actively support electric vehicles. The Government of Nepal (GoN) should also have a political commitment to the development of electric vehicles and conversion.

10.5 Others

1. Converted EVs should be exempted from VAT and other taxes.
2. If subsidy is provided in conversion cost, then people would be motivated towards conversion.
3. Parking in public parking spaces should be free for converted vehicle.
4. For converted EVs Battery charging should be done at minimum price and for that GoN should invest on public charging stations

11. Conclusion

In this research, five different case studies have been carried out and various aspects of sustainable development has been studied. History of vehicle conversion and present scenario was studied and found that some of the conversion initiation has been started by university students, engineers and private auto companies in Nepal. From the research we came to know that vehicle conversion is better than buying a new electric vehicle of same range and obviously much better than using petrol driven vehicle. People loves their new petrol vehicle, so they are interested to convert old one mostly above 15 years old vehicle. They were saying that cars of grandparent will be run by their grandchildren. From all of the case studies we came to know that vehicle conversion has different advantage in terms of initial cost, operation/maintenance cost and fuel efficiency. For cost benefit analysis, case 2 has been taken and compared all of the parameters in between converted EV, plugin hybrid vehicle, a new EV of similar range and a new petrol driven vehicle. From this we came to know that initial cost, operation and maintenance cost are relatively low for the converted vehicle. Vehicle conversion results on reduction of carbon emission which directly influence the human health and contribute to balance the natural ecosystem. In case 1, there has been calculated 3833 Tons of CO2 emission reduction annually resulted by 700 Safa tempos in Kathmandu valley and similarly in other cases also, emission has been reduced after the vehicle conversion. During research, study of socio-cultural perception towards vehicle conversion has been made and found some results. Converted electric vehicle are smooth without noise and vibration which contributes in creating peaceful environment in society. Vehicle conversion saves the economy of the society and nation that directly influence on livelihood of people and society. Vehicle conversion will create job opportunities and entrepreneurship. As we found that there is 60 percent women driver who drives safa tempos in Kathmandu valley. From the research, we came to know that running electric vehicles may contribute to some of the cultural aspects of our society. Place of cultural heritages can have peaceful environment and fresh air to inhale by tourists if vehicles are electrified. Vehicles used inside national parks for jungle safari and jungle inspection creates sound pollution so that animals may be disturbed. So those vehicles should be converted to electric. Meditation centers and Gumbas are disturbed due to noise pollution by engine vehicles. So if those vehicles are electrified, there would be less chances of disturbance.

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