NATIONAL STRATEGY FOR ELECTRIFICATION OF PUBLIC TRANSPORT

Under the National Consultation for transitioning to electric public transport –Nepal



Submitted to: UN ESCAP Transport Division

Submitted by: Er. Kamal R Pande

April 2020

Acknowledgment

I take this opportunity to express my special thanks of gratitude to the Ministry of Physical Infrastructure and Transport (MOPIT), particularly Mr. Keshab Kumar Sharma, Joint Secretary at the Foreign Cooperation Division, as well as Mr. Suresh Poudel, Senior Divisional Engineer at the Ministry for their strong support during the development of the strategy. MOPIT's commitment to electrifying the transport sector is evident from their continued engagement in terms of inputs and feedback on this important policy document.

Special thanks to UNESCAP, Dr. Madan Bandhu Regmi, Chief, Transport Research and Policy Section, UNESCAP, and Mr. Ryan Carvalho for initiating the process. Thanks also to Ms. Wanna Kunsabfueng, UNESCAP, for her continued support during the report preparation and the reviewers for providing their valuable comments.

Lastly, I would like to thank all stakeholders involved, including the Government of Nepal, private sector, civil society, academia, NGO/INGO including the Global Green Growth Institute, for their valuable input on the strategy. With this, I hope to see a swift transition of Nepal's transport sector to a more sustainable path.

I would also like to thank Mr. Anurag Pokharel for providing logistical and technical support in drafting the strategy.

EXECUTIVE SUMMARY

The Paris Agreement on climate change limits global warming to 1.5 degrees Celsius over pre-industrial levels. Thus, a quick and persistent reduction in greenhouse gas emissions is required. Nepal contributes very little to global emissions; however, the country's footprint is increasing with an annual average growth rate of 11.9% between 1990 and 2018. The transportation industry is one of the most energy-intensive sectors, accounting for 36% of national energy emissions. Electric Vehicles (EVs) can play a vital role in replacing fossil fuel-based Internal Combustion Engine (ICE) vehicles and reducing emissions. Public vehicles that travel the greatest distance per year in the country are one of the first targets for electrification.

The second Nationally Determined Contribution (NDC) filed by Nepal as a part of the Paris Agreement in 2020 aims for 20% of four-wheeler public vehicles sold in 2025 to be electric, with the share progressively growing to 60% in 2030 and developing 200 km of the electric rail network by 2030. Besides the Paris Agreement, Nepal is a member of several coalitions that advocate against climate change and promote sustainable transport development. Several national policy documents also broadly support the adoption of electric vehicles in the public transport sector. This strategy document intends to highlight the state of the public transport ecosystem as well as the barriers to transit to electric public transport and recommends strategic actions to overcome the barriers. The study conducted literature reviews and consulted concerned stakeholders to achieve the above- aims. The document is divided into the following four chapters:

Future Scenario
This chapter presents future scenarios of adopting four-wheeler public electric vehicles, specifically buses, and their emissions reduction potential for the next ten years. These are broad estimations based on fundamental assumptions. Detailed modeling and analysis will be required to draw a clearer picture for policy support. In the NDC scenario for 20% four-wheeler public vehicles penetration in 2025, 1,834 electric buses will need to be sold in that year, and for 60% in 2030, 8,466 units will need be sold. The primary assumption is that the sales of public buses will increase in a similar trend as seen in the past five years. The future emissions in the Business as Usual (BAU) scenario and the NDC scenario are projected in terms of Green House Gas (GHG) emissions and local pollutants emissions. In the BAU scenario, there will be an estimated 2,162 kilotons of GHG emissions (CO2, N2O, and CH4) in 2025/26 and 3,344-kilo tons of GHG emission in 2030/31. In the NDC scenario, GHG emissions is estimated to be 2,090 in 2025/26 and 2,680 in 2030/31.

Public Electric Transport Ecosystem
Although Nepal introduced electric mobility services such as the trolley bus and electric three-wheelers (*safa tempo)* in the past, the public electric transport ecosystem is still nascent. Achieving the NDC targets for public vehicles requires strengthening Nepal's components and factors that form the public electric transport ecosystem. The core components of the ecosystem are the manufacturing and procuring phases, the use phase, and the end-of-life phase that together complete the public electric vehicle life cycle. The governing factors are: policy, financing, resources, and knowledge that oversee the evolution of life cycle. Improving these can play a pivotal role in the proliferation of electric vehicles in Nepal.

Barriers
Lifecycle: Nepal's public vehicle operators are mainly informal, lacking fair competition. The upfront cost for purchasing electric buses is high compared to diesel. There is also limited support in establishing charging stations and land availability for the stations is a major concern. The

future of battery waste management seems challenging with the current lack of plans, policies, and actions to address this issue.

***Policy Barriers*:** Some policies are strong but have not come into action, while others have not comprehensively addressed the issues. The policy documents address social issues but lack tangibility and comprehensibility. There is poor horizontal and vertical coordination among government bodies.

***Financing Barriers*:** The upfront costs of electric vehicles and charging stations are high. There are no financing mechanisms available, making the transition slack. Financial institutions are cautious about providing loans to vehicle operators due to the number of ownership transfers from one operator to another, which have increased the default risks.

***Resources Barriers*:** There is a shortfall of skilled human resources for the electric vehicle ecosystem. Concerned college courses do not address this sector enough. There is also limited support for startups and innovations. Like the overall transport sector, the market is male-dominated.

***Knowledge Barriers*:** There is a lack of data and research in this field, similar to most sectors in Nepal. The database management and monitoring, reporting, and verification systems are poor.

Strategic Actions

Successful transition to public electric vehicles and meeting the national targets require stakeholders, such as Ministry of Physical Infrastructure and Transport (MoPIT), Department of Transport Management (DoTM), Ministry of Finance (MoF), Ministry of Energy, Water Resources and Irrigation (MoEWRI), Nepal Electricity Authority (NEA), Inter-Ministerial Coordination Committee, private sectors, local governments, and research agencies, to come out of silos and work together to address the identified barriers. They should take the following strategic actions.

Electric Public Vehicle Life Cycle

- Ensure accessible, safe, affordable, efficient, resilient, clean and low-carbon public transport.
- Expand the charging station networks strategically, explore the opportunities of establishing industries within the country, and be prepared for battery waste management.
- Promote private sector participation in each component of the life cycle.
- Explore innovative opportunities to strengthen the ecosystem.

Policy

- Form a committee for EV promotion within MoPIT and authority in NEA for handling the EV charging ecosystem.
- Explore the best platforms for coordination between ministries and the three-level of governments.
- Develop standards/guidelines for ICE vehicles to EV conversion, testing of products, repair and maintenance, assembly, and other processes depending on the present and future requirements for the ecosystem.
- Ensure policies are tangible, aligned with other policies and that they properly identify the needs of women and marginalized communities, and that they combined address the whole public electric vehicle ecosystem

Financing

- Develop financing mechanisms/models to promote the uptake of electric vehicles and charging stations. Identify the source and the agencies to manage funds for financing. Direct subsidy for early adopters could create momentum.
- Develop funds for incubation of startups
- Provide incentives to increase the participation of women and marginalized communities in the market.

Resources

- Build technical skills of engineers, researchers, and technicians.
- Design business-related capacity-building programs for potential parties while promoting the participation of women and marginalized groups. Design incubation programs to support startups and innovations.

Knowledge

- The government's plans should be built on robust studies and modelings that could steer development to a more dependable pathway.
- The government should prioritize robust data collection and management.
- Government should delegate more budget for research. Centres for excellence should be established and these institutions and other research organizations should be supported by the government’s funds and private sectors (for instance, through CSRs).
- Educational institutions should strengthen relevant curriculums to address the current need for building a strong electric vehicle ecosystem. They should collaborate with the government and private sectors to research issues.

ABBREVIATIONS

AAGR	Average Annual Growth Rate
AR6	Sixth Assessment Report
BAU	Business As Usual
BC	Black Carbon
BRT	Bus Rapid Transit
CSR	Corporate Social Responsibility
CH4	Methane
CO	carbon monoxide
CO2	carbon dioxide
DOED	Department of Electricity Development
DoTM	Department of Transport Management
EV	Electric Vehicles
GGGI	Global Green Growth Institute
GHG	Green House Gases
$GtCO_2e$	Giga tons of carbon dioxide equivalent
ICE	Internal Combustion Engine
KMC	Kathmandu Metropolitan City
KSUTP	Kathmandu Sustainable Urban Transport Project
LMC	Lalitpur Metropolitan City
MoEST	Ministry of Education, Science and Technology
MoEWRI	Ministry of Energy, Water Resources and Irrigation
MoF	Ministry of Finance
MoPIT	Ministry of Physical Infrastructure and Transport
MoUD	Ministry of Forests and Environment, Ministry of Urban Development
N2O	Nitrous Oxide
NADA	Nepal Automobile Dealers Association
NDC	Nationally Determined Contribution
NEA	Nepal Electricity Authority
NMVOC	Non-methane Volatile Organic Compound

NOX	Nitrogen Oxides
NPC	National Planning Commission
OC	Organic Carbon
PIK	Potsdam Institute for Climate Impact Research
PM 2.5	Particulate Matters 2.5
PTOMB	Province Transport Operation and Management Board
TDF	Town Development Fund
ToD	Time of Day
SDGs	Sustainable Development Goals
SO2	Sulphur Dioxide

CONTENTS

1. INTRODUCTION

Background

Nepal is a landlocked country of diverse topography located between India and China. It has an area of 147,181 km² within a short distance of 150 to 250 km from North to South. Due to its fragile ecosystem, uneven terrain, and low coping capacity, the country falls in the highly vulnerable geographic landmass. Nepal faces extreme climate events such as high-intensity rainfall leading to floods and landslides. Impacts of climate change further compound its vulnerability. The country falls in the top 20 of all the multi-hazard countries in the world[1] and ranks fourth in climate risks.[2]

IPCC's Sixth Assessment Report (AR6) provided empirical evidence and confirmed that anthropogenic emissions are changing our climate, whose effect would continue to impact living beings across the planet.[3] The impacts of climate change continue to increase worldwide. Around the world, water scarcity, erratic and extreme rainfall, other extreme weather events, receding snowlines, depleting glaciers, and drying springs are causing loss and damage.[4] A rapid and sustained reduction of greenhouse gases is needed to limit temperatures to 1.5 degrees from the pre-industrial level, as agreed in the Paris Agreement.[5] Nepal has contributed to emissions reduction in its Nationally Determined Contribution (NDC), with ambitious targets in emissions-intensive sectors, and pledged to achieve net-zero emissions by 2045 in its Long-term Strategy for Net-zero Emissions.

Global Greenhouse Gas Emissions

According to Potsdam Institute for Climate Impact Research (PIK), in 2018, China was the leading emitter of GHGs with 10.8 $GtCO_2e$ of CO2 emission, followed by the USA and India with 5.51 and 2.44 $GtCO_2e$, respectively.[6] Nepal's contribution to the global GHG emission was only 0.012 $GtCO_2e$. The per capita emissions were estimated to be highest in Qatar (46.73 tCO_2e), followed by Trinidad and Tobago (35.2 tCO_2e), and Brunei (35.2 tCO_2e). Similar to the total emissions, Nepal's per capita emission was only 0.42 tCO_2e. Although Nepal's contribution to worldwide emissions is negligible, emission in the country in recent years has been increasing rapidly, at an annual average growth rate of 11.9% between 1990 and 2018 (Figure 1).

---

[1] Maplecroft 2011, BCPR 2004 cited in Nepal Disaster Report 2015

[2] Eckstein, D., Hutfils, M.-L. & Winges, M., 2019. Global Climate Risk Index 2019, Berlin: Germanwatch.

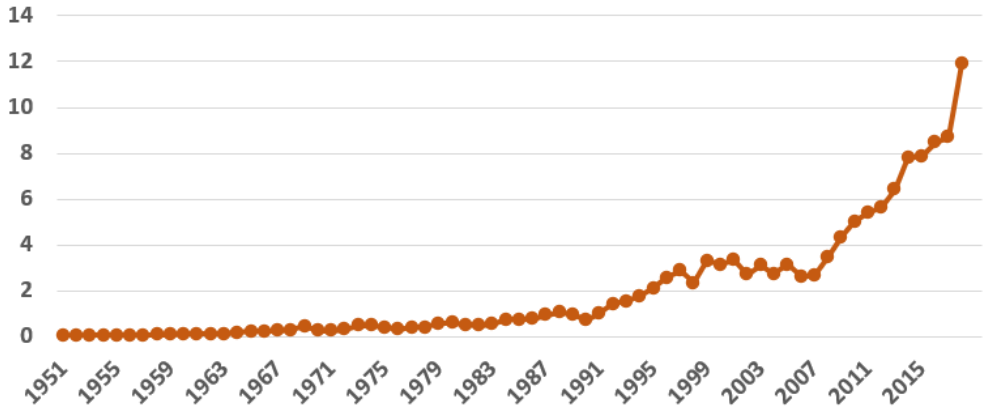
[3] IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [MassonDelmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.

[4] https://www.nepalitimes.com/opinion/back-to-glasgow-where-it-all-began/

[5] UNFCCC, 2015. Paris Agreement. Retrieved from: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[6] https://www.climatewatchdata.org/ghg-emissions

Figure 1: Nepal's Yearly CO2 Emission (MtCO2e)



Source:Climate Watch

1.1 Current Scenario – Weaknesses and Opportunities in Nepal

Increasing emissions in the transport sector

One of the most energy-intensive sectors of the country is the transport sector, which requires a transformational change. Transportation is the major contributor to surging energy-related emissions worldwide, accounting for around a quarter of carbon dioxide emissions globally and 36% in Nepal.[7] In addition, with the extension of the road network in recent years, development of transportation infrastructure, and growing income, the number of transportations in Nepal has been rising rapidly. The growth rate of vehicle registration from 1990 to 2018 has been 14%,[8] with the total number of vehicles registered in Nepal reaching nearly four million in 2021, as shared by MoPIT. Due to this increase in the number of vehicles, imported petroleum has surged with an average annual increase exceeding 9% since 1993/94 to fulfill the domestic fuel needs. All the vehicles running on fossil fuel are either diesel or petroleum-based. In 2019/20, Nepal imported 512,128 kilolitres of petrol and 1,473,536 kilolitres of diesel. Petroleum consumption has decreased slightly in 2020/21 compared to the previous years due to COVID-19 lockdowns, but experts estimate the sector will catch up as normal activities resume. This increasing consumption of petroleum has resulted in a surge in national emissions. It indicates the pertinent need to decarbonize the transport sector.

[7] GoN, 2021. Nepal's third national communication to the United Nations Framework Convention on Climate Change (UNFCCC). Available at: https://www4.unfccc.int/sites/SubmissionsStaging/NationalReports/Documents/986542371_Nepal-NC3-1-Nepal_TNC_Final.pdf

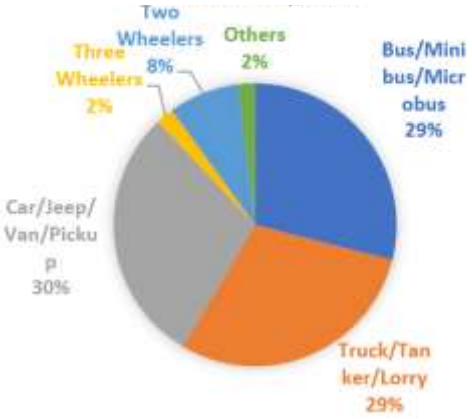
[8] DoTM Vehicle Registration Record. Available at: https://old.dotm.gov.np/en/vehicle-registration-record/

The share of different modes of transportation has been changing in the country, with private ownership of vehicles increasing significantly, by a proportion of 5% to 11% between 1990 and 2018. Two-wheelers are the dominant vehicle in the country due to their affordability and ability to cut through congested roads. The number of private four-wheelers is also increasingly plying on the roads. The share of public transportation has decreased from 11% to 5% between 1990 and 2018.[9] Because the per capita emission of private vehicles is higher than public, this shift further contributes to increasing emissions.

Pollution

Air quality in Nepal is deteriorating, especially in large cities. In Nepal, 42,100 deaths were attributed to air pollution (ambient and indoor) in 2019.[10] The in-patient morbidity data of Nepal (2018-19) showed that chronic pulmonary obstructive diseases were the top reasons behind in-patient admission (with 13,412 affected) and pneumonia occupied the third position for in-patient morbidities. For outpatient consultations in 2018-19, upper respiratory tract infections, headache, and ARI/lower respiratory tract infection occupied second, third, and fourth positions, respectively, thus indicating air pollution-related diseases are pretty common in Nepal[11]. From daily measurements, in recent years, Kathmandu has been rated as one of the top 10 most polluted cities.

Figure 2: Nepal's Yearly CO2 Emission from the Transport Sector (Excluding Aviation) in 2011



Source: Third National Communication Report, 2021

[9] Assessment of Electric Mobility Targets for Nepal's 2020 Nationally Determined Contributions (NDC). Available at: https://www.mofe.gov.np/downloadfile/E-mobility%20Assmnt%20NDC%202020_1623998131.pdf

[10] State of Global Air, 2020. Available at: https://fundacionio.com/wp-content/uploads/2020/10/soga-2020-report.pdf

[11] Annual Report: Department of Health Services 2075/76 (2019/19). Available at: https://dohs.gov.np/annual-report-2076-77-2019-20/

Nepal is rated as the country with the second-highest population-weighted annual average PM2.5 exposures in 2019 with an average concentration of 83.1 μg/m^3.[12] Vehicle emissions, particularly PM, are predicted to be the most significant cause of air pollution in the valley, according to Shakya et al. (2010). The bowl shape of Kathmandu Valley further exacerbates the situation when the polluted air cannot escape from the valley. Since EVs have zero tailpipe emissions, introducing EVs can help curb vehicular pollution and reduce morbidity and mortality cases.

Electricity Production

After Upper Tamakoshi Hydropower was connected to the national grid, Nepal's total national generation capacity reached 1910 MW as of November 2021. Today, 242 hydropower projects with a total capacity of 7,948 MW have received construction licenses from Department of Electricity Development (DOED).[13] Though the production was surplus in the monsoon of 2021, energy had to be imported from India during the dry season.[14] With the rapid boost in hydropower development in the country, the need to import electricity from outside is expected to end soon.

Furthermore, the second NDC report (2020) targets reaching a generation capacity of 15,000 MW.[15] As the current peak electricity demand is only under 1500 MW, the consumption will need to go up. There is a disparity in demand throughout the day as it peaks during 7 to 10 am and 5 to 8 pm, whereas it is low during nighttime (10 pm to 5 am).[16] The peak hours stressed the grid and generated energy could be wasted in the off-peak hours. Therefore, electric vehicles (EV) can be charged at night to utilize the off-peak hours. In that regard, this opportunity can be leveraged by adopting EVs. Through various policy measures, the government of Nepal has shown that it stands firmly behind deployment of EVs in the country, as discussed in Section 1.3.

National trade deficit

Petroleum is one of the major commodities imported to Nepal, and the value far surpasses the country's total exports. In 2019/20, the country imported petroleum products worth NPR 163 billion when the total export of commodity was NPR 98 billion. The import of petroleum contributed to more than 17% of the total commodity import. Adopting EVs can help replace petroleum use with nationally generated electricity. Converting old ICE vehicles to EVs can further reduce the consumption of petroleum products because of fuel replacement.

Import of vehicles has added significantly to the trade deficit. They had an import revenue of nearly NPE 90 billion in 2020/21, which was 22% of the total import revenue.[17] Assembly of electric vehicles in the country and conversion can therefore help to reduce the import of different vehicle types.

---

[12] State of Global Air, 2020

[13] https://www.doed.gov.np/

[14] NEA A Year in Review Fiscal Year 2020/21. Available at: https://www.nea.org.np/annual_report

[15] GoN, 2020. "Second Nationally Determined Contribution" Ministry of Forests and Environment, Government of Nepal". Available at: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Nepal%20Second/Second%20Nationally%20Determined%20 Contribution%20(NDC)%20-%202020.pdf

[16] NEA A Year in Review Fiscal Year 2020/21

[17] https://www.customs.gov.np/page/fts-fy-207778

1.2 Scenario of EVs in Nepal

Current Situation

Nepal pioneered in electric mobility with the introduction of electric three-wheelers (*safa tempos*) to replace diesel engine-powered three-wheelers (*bikram tempos)*[18] in Kathmandu in 1993/94. It was a successful collaboration between the private sector and the government in addressing pollution in Kathmandu Valley. The government of Nepal (GoN), however, placed a ban on the deployment of additional three-wheelers (including *safa tempos*) in Kathmandu since 2001 in an effort to minimize road congestion. Due to this, the total number of *safa tempos* has stagnated at around 700 in the country. E-rickshaws in the Tarai have been relatively successful, with a total of 36,294 assembled or imported by mid-March 2021.

Recently, there have been instances that suggest activities targeted toward the deployment of electric buses are gradually taking off. For example, Sundar Yatayat, a private transport company, operates four public electric buses in Kathmandu. Furthermore, ADB supported the procurement of five electric buses to service passengers traveling in Lumbini and Sajha Yatayat, a public transport cooperative, procuring 40 electric buses in its first phase of procurement is expected to be operational by 2022. It is estimated that only around one percent of the total vehicles registered in the country are electric.[19] Barriers to the uptake of EVs have been identified in Chapter 4.

With the challenges ahead, the task is to understand the state of public transport use and the plans and policies in Nepal, along with a national strategy to accelerate the transition to electric public transport fleets.

Need to Accelerate Deployment of Electric Public Transport

It is clear that the country needs to explore alternative fuels for vehicles to curb emissions from the transport sector and increase the country's energy security. Public transport that cover the highest annual mileage are the first target to address the reduction in CO_2 emissions since they have the highest contribution within the transport sector (see Figure 2).[20] In addition to that, private ownership of vehicles is increasing at an average annual growth rate of 15% between 1990 and 2018, which has resulted in further emissions and congestion, proving that it is necessary that the country look towards augmenting public vehicle fleets. One of the options to decarbonize the transport sector is the electrification of public vehicles, which plays a crucial role in meeting Nepal's target of achieving net-zero by 2045 (see Section 1.3 for more information on interventions in the transport sector to meet net-zero by 2045). [21]

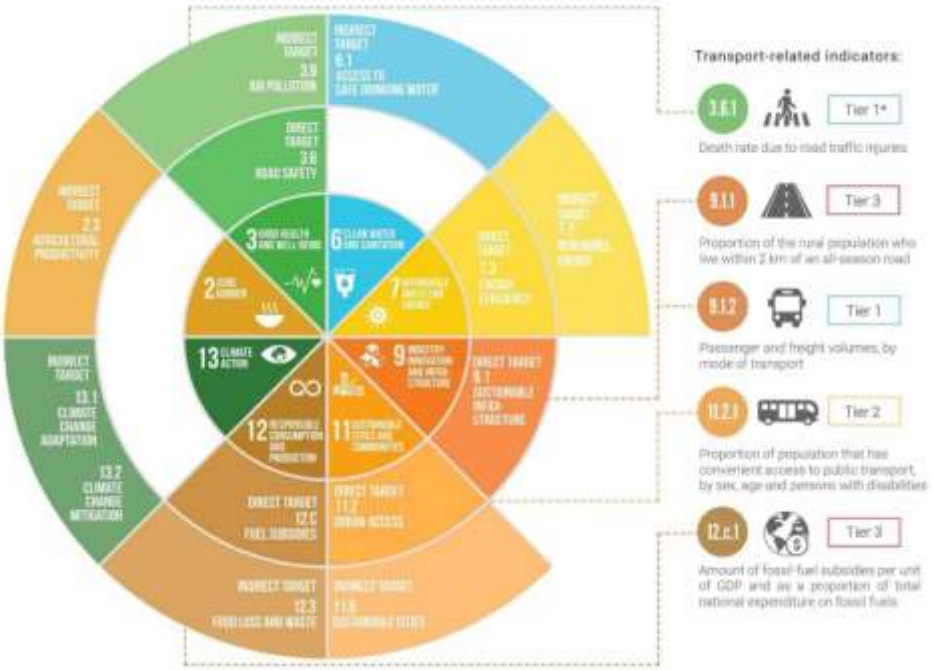
[18] Manufactured in India.
[19] E-mobility assessment conducted through market survey
[20] Third National Communication Report. Available at: https://unfccc.int/sites/default/files/resource/NepalLTLEDS.pdf
[21] Nepal's Committement at COP 26 Summit

1.3 Strategy's Alignment with National Policies

Nepal is a member of various alliances that advocate for climate change and sustainable transport development. It is pursuing the Sustainable Development Goals and is one of the signatories to the Paris Agreement and Kyoto Protocol. In line with these goals and the national needs, the government of Nepal has formulated plans and policies.

The Sustainable Development Goals have a specific target for public vehicles: Target 11.2 of Goal 11. This goal states, "By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons". This strategy aligns with other SDGs and indicators of the 2030 Agenda of Sustainable Development. There are five directly related and seven indirectly related targets, as shown in figure 3.[22]

Figure 3: Direct and Indirect Indicators Relating to Sustainable Transport



Source: SLOCAT

The Government of Nepal recently presented its enhanced Nationally Determined Contribution (NDC) under the Paris Agreement for the period 2021-2030, following Articles 4.2 and 4.11 of the Paris Agreement and Decision 1/CP.21 paragraph 23 and 24, and other relevant provisions of the Paris Agreement. The NDC considers the principle of common but differentiated

[22] https://slocat.net/our-work/2030-agenda-sdgs/

responsibilities regarding GHG mitigation and respective capacity in light of national circumstances. Nepal has set the following targets to electrify its transport sector by 2030:

- 20% of four-wheeler public vehicles sold in 2025 to be electric with the share gradually increasing to 60%[23] in 2030. It excludes e-rickshaws and electric tempos.
- Develop 200 km of the electric rail network by 2030 to meet passenger and freight transport demands.

Besides NDC, various policy documents promote the uptake of EVs, including public vehicles. Some of the key policies are as follows:

Table 1: National policies and how they have addressed sustainable public transport

Policy	Sustainable transport sector targets
Constitution of Nepal, 2015	Directive Principles for the State: • Increasing investment in the transportation sector by ensuring simple, easy and equal access of all citizens to transportation facilities, prioritizing environment-friendly technology, encouraging public transportation and quality private transportation, and making the transportation sector safe, well managed, and disabled friendly.
15th Periodic Plan (2019/20-2023/24)	Transport sector strategy • developing a road network based on a master plan • using modern technologies optimally by giving high priority to the development of the institutional capacity of the sector • making arrangements for alternative sources of investment and reducing dependence on traditional public sector resources • emphasizing the utilization of modern technologies and mechanization for design, construction, operation and maintenance of roads and road safety; and, • reducing possible impacts or adverse effects of natural disasters and climate adversities.
Bagmati Province Periodic Plan	Target • Replace all petroleum vehicles with EVs by 2085
National Transport Policy, 2001	Action plans • Encouraging private sector in environmentally friendly transport development such as cable cars in pilgrimage and tourist destination • Operate electric public transportation in the urban areas

[23] GoN, 2020. "Second Nationally Determined Contribution" Ministry of Forests and Environment, Government of Nepal". Available at: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Nepal%20Second/Second%20Nationally%20Determined%20 Contribution%20(NDC)%20-%202020.pdf

	• Limited period custom duty and tax exemption on environmentally-friendly vehicles, their parts, and construction material
Environment-Friendly Vehicle and Transport Policy, 2014	<u>Aim</u> • Increase the proportion of electric vehicles up to 20% by the year 2020 <u>Provisions and Targets</u> • Form a "Central environment-friendly vehicle and transport working committee", an "Environment-friendly vehicle and transport working committee", and in the local level as per need, an "Environment-friendly vehicle and transport management committee" for the promotion of production, operation, development, and prioritization of Nepal based industries • Establish an environment-friendly vehicle and transport development fund • Subsidize the production, conversion, and operation works related to environment-friendly vehicle and transport • Make arrangements for the availability of loans through banks and other financial institutions to individuals, companies, cooperatives, businesses for the development, production, and operation of environment-friendly vehicle and transport
Five Year Strategic Plan for Transport Infrastructure, 2073-78	<u>Proposed activities</u> • Expand the road network in urban areas to support safe and environment-friendly mass transport with dedicated lanes. • Operating Buss Rapid Transit (BRT) in eight primary and sixteen secondary routes in two years • Conversion of 20% of vehicles all over Nepal into EVs within the next five years • Take forward the construction of electric railways, namely Mechi-Mahakali railway, Rasuwagadhi-Kathmandu-Pokhara-Lumbini railway, and detailed study of possible metro rail routes in Kathmandu valley. • Improve the overall management of public transport.
Nepal Action Plan for Electric Mobility	<u>Priority Areas of Action</u> • Unit for electric mobility • National program for electric mobility • National financing vehicle for electric mobility
Kathmandu Valley Air Quality Management Action Plan, 2076 (2020)	<u>Action Plan</u> • Develop charging systems and bus terminals with charging stations within one year. • Arrangement to allow only environmentally-friendly vehicles such as public buses, cycles in ten touristic and culturally significant areas by five years. • Make political arrangements to allow conversion of old ICE vehicles into EVs within two years.

	• Develop an integrated public transport network by two years. • Within three years, conduct a detailed feasibility study of Mass Transit Systems and create a dedicated bus lane for BRT in at least one of the roads that have more than six lanes.
National Environment Policy, 2019	Targets • Increase the use of environment-friendly technology in the operation of vehicles Strategies • Encourage the use of environment-friendly transport such as electric, hybrid, and hydrogen vehicles and make the necessary arrangements for their promotion
National Climate Change Policy 2019 (2076)	Strategies and policies • Encouraging the use of electric vehicles • Encouraging and mobilizing the private sector in emission reduction in transportation. • Phasing out the vehicles that have crossed the certain running period limit.
White paper on energy, water resources, and irrigation sector 2018	Aim • Make the necessary policy and infrastructure arrangements for electric mobility with a vision that 50% of imported vehicles will be electric by 2023
Nepal's Long-term Strategy for Net-zero Emissions, 2021	• In the With Additional Measures (WAM) scenario (includes the impact of additional mitigation actions introduced after 2020), the strategy estimates that the GHG emissions reductions in the transport sector will be around 97% by 2050, compared to the reference scenario.

1.4 Stakeholder Analysis

Electric public transport stakeholders were identified through in-depth discussion with the Ministry of Physical Infrastructure and Transport (MoPIT). Key stakeholders are briefly introduced below.

Parliament: The Federal Parliament of Nepal is the supreme assembly (legislature) with the authority to make laws for the country which came in action since the formulation of the 2015 Constitution. It is composed of the National Assembly and the House of Representatives. The House of Representatives consists of 275 members and its main tasks are to build the government's structure, make laws, and passing of the budget among others. The National Assembly is composed of 59 members. Providing expert service, making laws, making the government liable are some of the major tasks of this authority.

Council of ministers: The council of ministers holds Nepal's executive power, and they are to issue general directives and control and regulate the governance of Nepal. The provision is that when any Ministry / Commission / Central level body has to decide on any of the issues mentioned in Schedule 1 of Government of Nepal's Guidelines, 2008 it has to be submitted to the Council of Ministers. The issues such as drafting a new act or amending the existing act are submitted to

the legislature as a bill after the decision of the Council of Ministers, while other administrative decisions are sent to the concerned ministry / commission for implementation.

Federal, Provincial, and the Local Government: There are 753 local governments, seven provincial governments, and a federal government in Nepal as per the Constitution of Nepal, 2015. There are separated and concurrent powers delegated to these three levels. The federal government can make acts, policies, and national plans and programs to support effective adoption of EVs. The provincial and local governments can address the issues of EVs in their periodic plans or make specific programs at their levels. They can also form committees or authorities to work on successful EV transition. The Bagmati Province has formed a Province Transport Operation and Management Board. Some local governments such as the LMC and KMC have taken initiatives to increase the uptake of public electric vehicles. Aside from them, most local governments do not have this in their priority. Local-level government in coordination with the DoTM can shape the public transport system to cater to their specific needs and innovate in their capacity. They can take actions such as providing public EV operators with suitable government lands such as charging spaces and pilot fleets.

Ministries and departments: There are altogether 15 ministries in Nepal that manage different sectors of public administration. They are responsible for forming policies and implementing the decided plans and programs. Ministry of Finance (MoF), Ministry of Physical Infrastructure and Transport (MoPIT), Ministry of Energy, Water Resources and Irrigation (MoWERI), Ministry of Forests and Environment, Ministry of Urban Development (MoUD), and Ministry of Education, Science and Technology (MoEST) along with their departments will be the major contributors for sustainable EV ecosystem development. The Department of Transport Management (DoTM) under MoPIT will be a key player as it holds the authority to manage public vehicles.

National Planning Commission (NPC): The NPC is an advisory body of the Government of Nepal (GoN) that evaluates resource requirements, determines financing sources, and allocates funds for socio-economic development. It is in charge of monitoring and analyzing development policies, plans, and programs. One of its major products is the Periodic Plans, based on which sector-specific plans and strategies are based.

Town Development Fund (TDF): TDF was established in 1989 by the Government of Nepal as an autonomous financing body and is under the Ministry of Urban Development (MoUD). It helps finance urban development projects with the government's support and national and international agencies. This institution can flow funds for developing an EV ecosystem in the public transport sector. ADB introduced one of its works on public vehicles, the Kathmandu Sustainable Urban Transport Project (KSUTP), as a financial institution to support sustainable transportation in Kathmandu. Under this project, the public vehicle service *Digo Sarbajanik Yatayat* (Sustaibable Public Vehicle) was established to replace the unmanaged bus service in the Sinamangal to Gongabu route. The financing model was as follows:

- 80% soft loan at 5% interest rate
- 15% grand from TDF
- 5% equity from public bus operators of the that route

TDF is currently leading a proposal on EBRT to be submitted to the GCF. The team has identified five routes in the Kathmandu valley to introduce EBRT. Three of them will be radial routes inside

the Ring Road, two will run on the Ring Road itself, and one will connect Suryabinayak to Ratna Park. The tentative financing model of the proposed project will be as follows:

- 40% as grant component
- 30% soft loan
- 30% co-financing by the Government of Nepal

National Electricity Authority (NEA): NEA lies under the Ministry of Energy, Water Resources, and Irrigation. Its main role is in generating, transmitting, and distributing electricity in Nepal. It has the monopoly in the management of the national grid and is responsible for providing a reliable electricity supply to the consumers. NEA is authorized to develop the country's charging infrastructure ecosystem.

Province Transport Operation and Management Board (PTOMB): This board was formed in 2020 under the Bagmati Province to promote and manage public electric vehicles in the province. It has yet to receive funding for carrying its work forward.

Private Sectors: Private sectors can be seen as three different types:

Suppliers of vehicles: These are entities such as Nepal Automobile Dealers Association (NADA).

- With appropriate marketing and financing they can bring the necessary types and numbers of EVs in the market; They need to be in line with what the government is proposing
- They can also help build consumer confidence.

Consumers: They can be individuals or large entities such as the hotel industries, malls.

- Consumers will adopt EVs if there is government's support;
- Larger consumers need to be aware that adopting EVs will be profitable in the long run and being an early adopter can create ripples in the market. Tourism, education, and other service sectors are some of those consumers who could be early adopters;

Operators: These are service providers such as Sajha Yatayat, Sundar yatayat.

Universities: Currently, there are 11 universities in Nepal providing a variety of courses for study and research. Universities can conduct valuable research related to technical, social, and economic aspects of EV adoption and contribute in knowledge generation. They can also increase some focus on EVs by revising curriculums where relevant. They can share findings with practitioners and the public and train government and non-government officials, the private sector, media.

International agencies: They could provide financial and technical expertise and influence Nepal Government in promoting public EVs. Some of the active agencies/organization under this category are UNESCAP, GGGI, UNCRD, Asian Development Bank, JICA.

NGOs, Think Tanks and CBOs: These institutions can support with their technical expertise. They can conduct policy research and share recommendations with the government. Different CSOs could collaborate and build alliance to advocate, campaign, and debate EVs. They could form pressure groups, collect petitions, use social media and other creative platforms to generate mass awareness on EV adoption, and advocate for policy change.

Stakeholders were mapped based on the level of their interest and their power to make an influence. All stakeholders must be involved in various levels of project development. Those with low power high interest could be empowered by acknowledging their importance and involving them in planning process. Those with low interest could be made aware or sensitized about their potential contribution, the importance of that for bringing the transition, and also the possible benefits for their side. Various stakeholder engagement plans for individual projects related to electric mobility in Nepal may be developed based on the stakeholder matrix presented in Table 2. The stakeholders with high power and interest should be consulted throughout the implementation of the strategy. Stakeholders that have high power and low interest will need to be continuously engaged in the decision making processes to ensure there are no roadblocks during strategy implementation. It is also extremely important to keep all stakeholders informed of decisions and priority actions to successfully achieve the country's target on electric mobility.

Table 2: Stakeholders mapping for electric public transport

High Power Low Interest	**High Power High Interest**
• Parliament • Council of Ministers • National Planning Commission • Ministry of Finance • Ministry of Education, Science and Technology • Ministry of Industry, Commerce and Supplies • Ministry of Urban Development (MoUD) • Local governments (with few exceptions) • Financing Institutions	• Ministry of Physical Infrastructure and Transport (MoPIT) • Ministry of Forest and Environment (MoFE) • Ministry of Energy, Water Resource and Irrigation (MoEWRI) • Department of Transport Management (DoTM) • Province Government • Nepal Electricity Authority (NEA) • Town Development Fund (TDF) • Multilateral Agencies • UN and Bilateral Agencies • Public Transport Operators
• Transportation Consumers • Municipal Association of Nepal	• PTOMB • Individuals, Enterprises, and Entrepreneurs engaged in the public transport value chain • Development Organizations (NGOs/CBOs) • Associations • Universities
Low Power Low Interest	**Low Power High Interest**

Public Electric Vehicles

During the study period, stakeholder consultations were conducted in two stages. The first stage covered bilateral meetings with key stakeholders, which took place between October and December 2021. In the second stage, MoPIT hosted a consultation meeting with higher government officials on November 9, 2021 (see Annex 1 for participants list). The consultations focused on electric public transportation in Nepal, its challenges, policy gaps, and priority action areas. More broadly, barriers around the uptake of public electric vehicles were identified, and priority actions to address these barriers were discussed during the consultations.

1.5 Structure of The Strategy Report

This section briefly outlines the contents and the purpose of the following chapters. These chapters aim to bring forward strategies that would support a successful transition to public electric vehicles.

Chapter 2 - Future Scenarios

This chapter puts forward future scenarios for four-wheeler public electric vehicles adoption and emissions for the next ten years. The scenario is developed through basic projections. These estimates present a broad picture of the electric mobility sector until 2030. A further detailed analysis that incorporates all variables impacting the adoption of vehicles will be required if the government and private sectors are willing to make evidence-based interventions. Such projections will aid in formulating specific plans and programs such as the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme in India.

Chapter 3 - Public Electric Transport Ecosystem

This chapter presents the components that essentially make up the complete electric public vehicle transportation and the factors that govern those components. It briefly describes these components and factors concerning Nepal’s context. This ecosystem intends to be a framework for assessing the barriers and seeking strategies to overcome those barriers. It constitutes the core components such as Importing, Manufacturing and Procuring, Use, and End-of-life phases. These collectively form the life-cyle of public electric transport. Other parts of the ecosystem are Policy, Financing, Resources, and Knowledge which are the governing factors of the core components.

Chapter 4 - Barriers

This chapter compiles the barriers to a successful transition to public electric vehicles identified from consultations and literature reviews. It reviews those barriers in terms of the public electric transport ecosystem's core components and governing factors.

Chapter 5 - Strategic Actions

The final chapter seeks to identify strategic actions that would overcome the barriers faced by the public electric transport ecosystem. Each action requires efforts from specific stakeholders and synergies between all of them.

2. FUTURE SCENARIOS

The first part of this section analyzes the number of electric micro/mini, and larger buses (collectively referred to here as e-buses) sales that will be required to achieve the targets set for public transport in Nepal's second NDC. It corresponds to the four-wheeler public transport targets but excludes the case of taxis due to limitations on the availability of data. This analysis assumes that the targets for all public passenger buses are the same (see Table 3).

Table 3: Electric Public Vehicle Targets in Nepal's NDC.

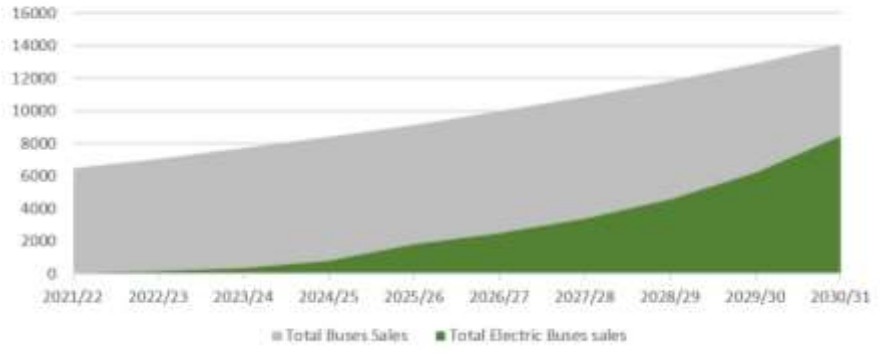
E-bus	2025 target	2030 target
Large Electric Bus	20% of new large bus sales	60% of new large bus sales
Mini Electric Bus	20% of new minibus sales	60% of new minibus sales
Micro Electric Bus	20% of new microbus sales	60% of new microbus sales

The second part presents the projected emissions from all types of buses in two scenarios: Business as Usual (BAU), where the increase in sales of e-buses will be as per the current estimated growth scenario, and the NDC, where e-bus penetration will be as projected in the first part.

2.1 Electric Bus Sales in NDC scenario

Due to the availability of data till 2019/20 only[24], the following analysis takes this year as the base year. In the last ten years, the AAGR of public buses (micro/mini, and large buses) in Nepal has been around nine percent. As there is no case of establishing alternative mass transits such as metro rails soon, and only 200km of railway construction is targeted for the year 2030, the AAGR is taken as 9% which is similar to the previous years. In the year 2025/26, the sales of all buses are expected to be around 9,170 units, reaching 14,100 in 2030/31.

Figure 4: Projected Electric Buses Sales to Reach the NDC Targets



[24] Vehicle registration data: https://old.dotm.gov.np/en/vehicle-registration-record/

To achieve NDC targets, the AAGR for electric bus sales is estimated to be around 120.4% (2019/20 to 2025/26), whereas the AAGR is estimated to be 35.78% (2026/27 to 2030/31). If these targets are met, around 1,834 electric buses will have to be sold in 2025/26 and 8,466 in 2030/31. Cumulatively, about 3,291 electric buses (2,699 buses and 592 mini/micro buses) will be plying the streets of Nepal in 2025/26 and 28,408 (24,071 buses and 4,337 mini/micro buses) in 2030/31. These buses are assumed to replace the old buses older than 20 years[25] and augment the existing fleets. Considering every year vehicles registered 20 years back are taken out of service, 6079 units will have to be replaced between 2021/22 and 2025/26 and 8,881 between 2026/27 and 2030/31.

The projection of total bus sales and electric bus sales under NDC scenario from 2021/22 to 2030/31 is shown in Figure 4 and the unit of electric bus sales are listed in table 4.

Table 4: Estimated electric buses sales from 2021/22 to 2030/31 under the NDC scenario

Year	Electric Bus	Electric Mini/Micro Bus	Total
2021/22	50	24	74
2022/23	118	44	162
2023/24	280	81	361
2024/25	661	149	810
2025/26	1,560	274	1,834
2026/27	2,118	373	2,491
2027/28	2,876	506	3,382
2028/29	3,905	687	4,592
2029/30	5,303	933	6,236
2030/31	7,200	1,266	8,466
Total	24,071	4,337	28,408

(source: author)

Charging requirements

Land: For charging infrastructure and associated land requirements, assuming the average charging/parking space required for each bus on average is 100 sq. m, a total of 334,000 sq. m of land will be required by 2025/26. These lands would be distributed around cities depending on business model for bus operations.

Energy: Estimating the average trip distance per day to be 125km in urban areas, a battery capacity of 130kWh or over would be required to run on a single charge (assuming the efficiency

[25] Based on the Five Year Strategic Plan for Transport Infrastructures 2073-79 (https://soten.org.np/uploads/medias/post/full/1603183486_Five%20Years%20Strategic%20Plan%20Transport%20Infrastructures%202073-2078.pdf) and the ban to operate public vehicles older than 20 years set by the government on March 2016 (https://thehimalayantimes.com/kathmandu/twenty-year-old-public-vehicles-banned)

to be 1.2 km/kWh[26] and leaving a safe space). Daily, 434,200kWh of energy would be consumed, which will amount to 134 GWh in one year (assuming 310 days of operation).

Charging stations: Typically, public vehicles run from 4.30 am to 9.00 pm in cities.[27] The time available for charging would, therefore, be 7.5 hours. When using fast chargers of 140kW capacity with three ports,[28] three buses can be charged in about an hour. Thus, around 21 buses could be charged with a single station in one night. For 3,340 buses, roughly 160 fast-charging stations would be needed. However, because several operators might own less than 21 buses, which is the prevalent case in Nepal, many stations might be required, or a sharing modality would need to be adopted.

Table 5: NDC scenarios of electric buses

Necessary condition for Electric Buses in NDC scenario	Unit	2025/26	2030/31
Vehicle sales (Electric buses)	Number	1,830	8,460
Total electric buses on the road	Number	3,340	28,510
Total area required for charging	Sq. m	334,000	2,851,000
Total daily energy consumption	GWh	0.434	3.7
Number of charging stations (minimum)	Number	160	1,357

(source: author)

2.2 Future Emissions

This section presents the projected GHG and pollutants emission in the Business as Usual (BAU) scenario and where NDC targets are met (again, taking 2019/20 as the base year). The projection assumes that the vehicles will run for 310 days, and each year, ICE vehicles that have reached 20 years of operation will have to stop their service. The emission factors used for the calculations are provided in the table below:

Table 6: Emission factors for different buses

Vehicle Type	Micro/Minibus	Bus
Fuel	**Diesel**	**Diesel**
CO2	198.25	571.95
CH4	0.06	0.00
N2O	0.00211	0.04
NOX	1.69	9.07
CO	1.50	9.35
NMVOC	0.21	2.35
PM2.5	0.39	0.25
BC	0.26	0.16
OC	0.08	0.05
SO2	0.01	0.02

Source: IPCC[29]

[26] GGGI Pre-feasibility of Electric Buses

[27] https://www.worldbank.org/content/dam/Worldbank/document/SAR/nepal/Gender-and-Public-Transport-in-Nepal-Report.pdf

[28] This is equivalent to the capacity of charging stations that NEA is installing

[29] https://www.ipcc-nggip.iges.or.jp/public/gp/bgp/2_3_Road_Transport.pdf

GHG Emission

Figure 5 presents the projected scenario of GHG emissions. It includes the emission of Carbon dioxide (CO2), Nitrous Oxide (N2O), and Methane (CH4). The total GHG emission in the year 2025/26 in the BAU scenario is expected to be over 2,162 kilotons, and the numbers are expected to rise to 3,344 kilotons in 2030/31. The AAGR of E-buses in the BAU scenario is estimated through the least squared regression of the limited years of sales. In the NDC scenario, where the number of vehicles will increase as projected in the above section, the emissions will be limited to around 2090 and 2,680 kilotons in 2025/26 and 2030/31. The estimated emissions from each gas are provided in table 7.

Figure 5: Projected Emission from all types of buses in BAU and NDC Scenarios (kilo tons)

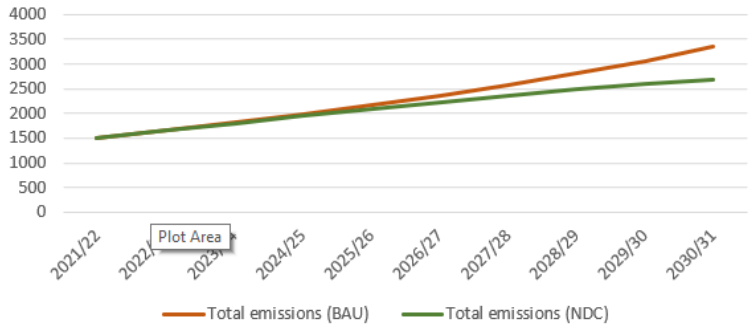


Table 7: CO2, N20, and CH4 emissions from all types of buses in BAU and NDC scenarios

Gases (kilo tons)	2025/26		2030/31	
	BAU	NDC	BAU	NDC
CO2	2,162	2,090	3,344	2,681
N2O	0.14	0.14	0.22	0.18
CH4	0.027	0.026	0.043	0.035
Total	2,162	2,090	3,344	2,680

Local pollutant emissions

The calculation takes Particulate Matters (PM 2.5), Black Carbon (BC), Sulphur dioxide (SO2), Nitrogen Oxides (NOX), Carbon monoxide (CO), Non-methane Volatile Organic Compound (NMVOC), and Organic Carbon (OC) into account for the local pollutants projection. Figure 6 shows the projection of the three major pollutants: PM 2.5, Black Carbon, and SO_2. All types of public buses are expected to release 2881.8 tons of these three pollutants under BAU and 2314 tons in the NDC scenario in 2030/31.

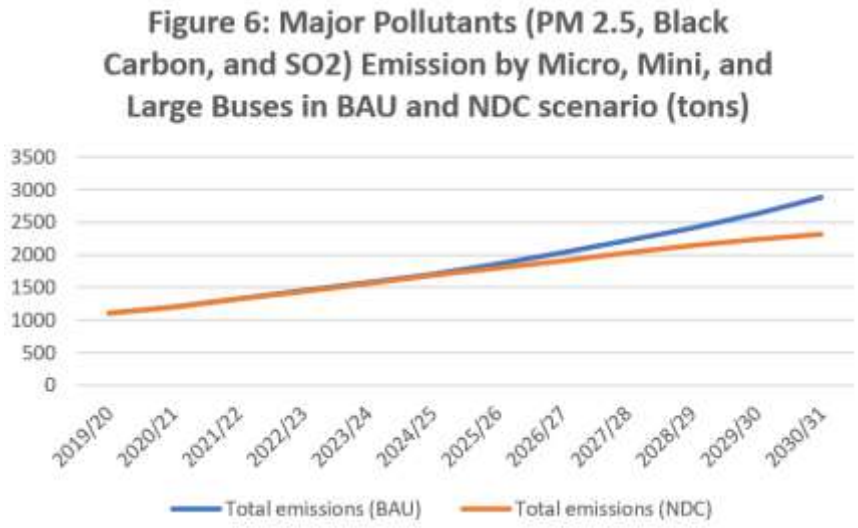


Table 8: Pollutants emissions from all types of buses in BAU and NDC scenarios

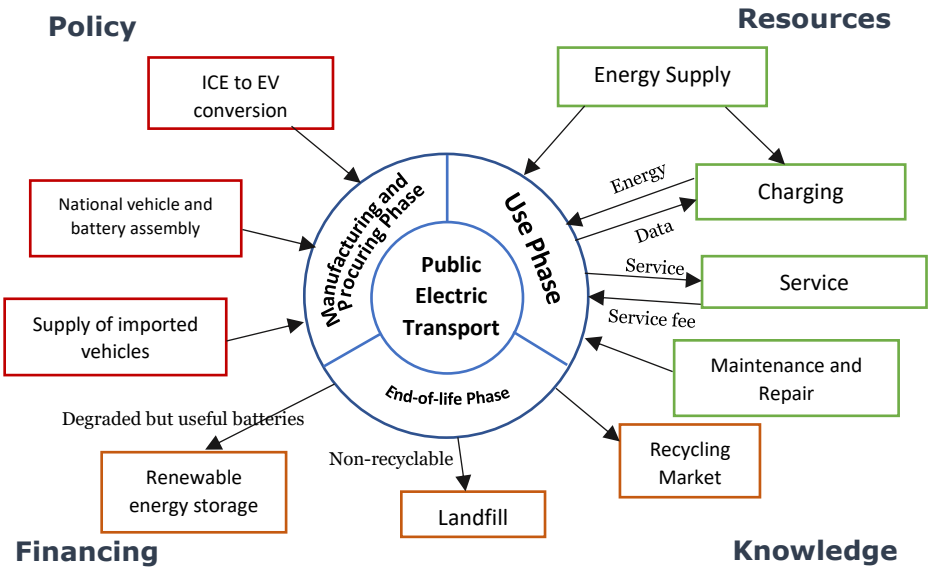
Local Pollutants (kilo tons)	2025/26		2030/31	
	BAU	NDC	BAU	NDC
PM 2.5	1,084.85	1,047.65	1,680.00	1,349.50
BC	699.10	675.09	1082.67	869.76
SO2	77.04	74.44	119.14	95.54
NOX	33,630.04	32,502.20	51,983.90	41,665.50
CO	34,556.88	33,398.60	53,414.50	42,809.90
NMVOC	8,608.60	8,320.49	13,304.80	10,661.95
OC	217,891.40	210,415.52	337,436.90	271,069.73

3. ELECTRIC PUBLIC TRANSPORT ECOSYSTEM

In Nepal, public transport is largely financed and operated by the private sector, which is yet to be formalized.[30] In 2018, MoPIT issued a mandate for all public vehicle operators to be registered at the Company Registrar's Office. Although operators are gradually getting associated with a company in some form or the other, most are still a part of associations and the association still does not share profits equitably to the members and have continued to work in a conventional manner. Thus, the public transport sector in Nepal is largely informal.

An electric transport ecosystem is needed to deploy public electric vehicles in the country effectively. The ecosystem comprises the cost of the electric public transport life cycle and the various governing factors that support it. The core components are energy, services, and data generated and consumed, and the governing factors aid in making the ecosystem viable and sustainable.

Figure 7: Electric Public Vehicle Ecosystem



3.1 Governing Factors

The state of the public electric transport ecosystem is broad, governed by four factors: Policy, Financing, Resources, and Knowledge. These impact the core components sphere, and these categories are lightly adapted from Nepal's National Action Plan for Electric Mobility, 2018.

The policy defines the landscape for public electric transport based on national and worldwide needs. Financing makes new initiatives possible when the usual flow of the market does not support it. As electric vehicles are new to the dominant fossil fuels market, financial support can help make adoption economically viable. The availability of adept human resources will make the

[30] Registering as a cooperatives or individual operators registered as a social entity.

ecosystem run seamlessly and strengthen the other governing factors. Knowledge will help strengthen the social, technical, and economic aspects of the whole ecosystem.

3.2 Core Components

Importing, manufacturing, and procuring phase

Supply of Imported Vehicles: The 2021/22 budget imposes 10-40% customs duty depending on the motor's capacity, it has exempted the excise duty, and the road tax is set at 5%. Currently, India and China are the possible suppliers of electric vehicles. The pre-feasibility of electric buses conducted by GGGI[31] in coordination with Sajha Yatayat has shown that electric buses are economically viable in Nepal. The study compared the cost of three electric buses available in the market for Nepal to a diesel bus of similar specification. It concludes that the life cycle cost of two electric buses was 24% and 39% cheaper than the diesel bus while the third option was 1% more expensive. The cost summary is presented in Annex IV. Institutions such as Sajha Yatayat and Sundar Yatayat are on their way to import 40 and 20 electric buses respectively.

To ensure that the imported vehicles are of high quality, it is necessary to develop standards both for vehicles and charging stations in the country. Currently there is support from the development partners to develop the necessary minimum specifications and standards for vehicles. The Nepal Electricity Authority and Ministry of Physical Infrastructure and Transport are working towards developing standards for the charging stations as well.

Vehicle and Battery Assembly: As the upfront cost of electric buses is much higher than their diesel counterparts, the GGGI study explores the possibility of local manufacturing of electric buses, which can make them significantly cheaper. GGGI provides a crude estimate that the cost of assembling a 5-meter bus with a passenger capacity of 20 to be in the range of NPR 900,000 to 1.5 million. A detailed analysis is required to that cover economies of scale, standards, and the value chain. Currently, there are only some[32] electric three wheelers assembly plants in the country. Supporting policies will need to be in place for commercial manufacturing/assembly of both for fossil fuel and electric vehicles in Nepal. As batteries are expensive to replace, assembly plants could be piloted and then expanded in the future.

It is important that the government develop standards for vehicles manufactured within the country. Currently there are no standards, regulations that support testing of vehicles manufactured in Nepal.

ICE to EV Conversion: Stakeholders have shown interest in ICE to EV conversion in Nepal arguing that conversion could be a cost-effective option for EV uptake for countries like Nepal that have limited budgets to make make a transition. Private sectors in Nepal working on conversion share that buses, if retrofitted on 100-500 units could be 30-45% cheaper than a new e-bus and if battery assembly plants could be established in the country, the cost would be further reduced. 14,722 buses and 2,478 microbuses were

[31] https://gggi.org/site/assets/uploads/2018/07/GGGI-Nepal_Pre-Feasability-of-Electric-Buses.pdf
[32] http://global.chinadaily.com.cn/a/202108/16/WS6119d602a310efa1bd6690ab.html

registered in Nepal 10 to 20 years ago. Assuming 10% of them would be fit for conversion, nearly 1,500 buses, and 250 microbuses at different years would be available for the purpose. DoTM is currently formulating guidelines for vehicle conversion. Piloting and further research and development could indicate if this option is viable to support the country meet vehicle electrification targets.

There is currently support from development partners to develop standards for vehicles converted to electric.

Use Phase

Service consumption: The Urban Transport Improvement of Kathmandu, JICA report[33] estimates that the valley's population will be four million by 2030. The GDP would be over USD 900, and to accommodate the mobility of this scale of population, mass transit would be vital. The development of the electric public vehicle ecosystem needs to center around the consumers to provide inclusive, reliable, affordable, manageable, accessible, and clean service.

Electricity supply: Since the 456 MW Upper Tamakoshi Hydropower started its full operation in September 2021, energy in Nepal surplus in the wet season. The second NDC report submitted in 2020 has set a target to reach a generation capacity of 15,000 MW.[34] Nepal is, thus, energy-rich, and rapid electrification of the transportation sector is possible. Large scale hydrogen production from electricity is also being explored in the country[35] and opportunities to use it as a fuel in the transport sector could be explored. In 2020, less than 0.05% of the total national electricity sales were for transportation, and in 2019 it was 0.08%.[36] According to NEA, the grid can handle the targeted transport electrification, however, more evidence based analysis would be required to understand the implications of increasing demand from the transport sector.

There are electricity tariff incentives in place that could support the adoption of EVs by the public sector. There are three different tariff schemes for transportation consumers. The first is for consumers with regular meters, the next for those with Time of Day (ToD) meters, and the last for commercial service providers with automatic swap cards such as commercial charging stations. Under the medium voltage category (the charging stations for public vehicles will fall under this category) with conventional meters, the tariff for charging stations is 5.6 NRs/kWh, which is cheaper than all sectors except for water supply.[37] According to the Time of Day (ToD) tariff, for the months of Baisakh to Mangsir,

[33] https://openjicareport.jica.go.jp/pdf/12289682_01.pdf

[34] GoN, 2020. "Second Nationally Determined Contribution" Ministry of Forests and Environment, Government of Nepal". Available at: https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Nepal%20Second/Second%20Nationally%20Determined%20 Contribution%20(NDC)%20-%202020.pdf

[35] Hydropower to Hydrogen in Nepal: Opportunities, Challenges, and Way Forward. Report available at: https://www.ntnu.edu/documents/1270974211/1279942213/H2H+Nepal+Webinar_Final+report_17+Sept+2020.pdf/2fa90a4b-8db3-6af6-da25-be7f4aeceb23?t=1600777235863

[36] NEA, 2021. "A Year in Review Fiscal Year 2020/2021". Available at: https://www.nea.org.np/admin/assets/uploads/annual_publications/Annual_report_2020.pdf

[37] NEA, 2020

the off-peak energy charge is 4.45 NRs/kWh for the 33kV category and 5.05 for 11KV. These rates are nearly half that of the peak time and less than three-fourths of the normal hours. For battery-operated public vehicles, charging during the off-peak hours will be the norm; therefore, the reduced charge will be encouraging. The automatic swap card users scheme also have Time of Day rates whereas they do not have to pay the demand charge. For domestic consumers, however, there is no dedicated tariff incentive. The tariff rates for the three available schemes are presented in Annex III.

Charging systems: Charging infrastructure is in a nascent state in Nepal. NEA is currently building 50 public fast-charging stations in 30 locations of Nepal, focusing on the major highways of Tarai and major cities. Five stations will be installed in Province 1, seven in Province 2, 20 in Bagmati Province, of which seven will be in Kathmandu valley, six in Gandaki Province, eight in Lumbini, one in Karnali, and three in Sudurpaschim. The lands are selected based on security, accessibility, area, topography, and government lands are in priority. The bus parks designed by the Town Development Fund (TDF), refreshment centers made by the government, and lands provided by the local level governments are among the targeted government lands. As this is only a pilot initiative, detailed research has not been done to determine the best locations. The work has already started and NEA expects it to finish within six months. Each station will be have a DC fast charger of 142kW capacity and three ports will be available. A solar-powered charging facility was opened at the end of 2021 in Lumbini. This development was supported by ADB and handed over to the Lumbini Development Trust after completion. The facility houses 13 7kW chargers and three fast chargers.[38] Private companies such as Sundar Yatayat and vehicle sellers have also installed charging stations in different parts of the country. For public vehicle fleets, depots will be required for which a certain area of land should be available. The land will house components such as transformers, chargers, and parking infrastructures which are designed based on the characteristics of the fleet.

Robust software for charging is an essential component of a charging system, and it will help to schedule charging, monitor the system, and collect data. The charging systems should be able to collect data and that should be in an ethical and secured manner. Also, use of Lithium Titanate (LTO) or supercapacitors which have high rate of charge and discharge could complement the typical Lithium ion battery and charging system or also be used as alternatives in selected cases. There are also alternatives to plug-in charging that could be explored. For instance, the *Safa Tempos* use battery swapping for reducing the waiting time for the fleet. Trolley buses and trains do not use batteries, thus reducing the hassle of battery waste management. The country has experience with trolley buses and is working towards developing train infrastructure.

Maintenance and repair: The motor and battery are the major components that differentiate an electric vehicle from an ICE vehicle. Batteries are sensitive technologies and handling them can be hazardous, especially lithium-ion batteries. A robust repair and

[38] https://kathmandupost.com/money/2021/12/29/nepal-s-first-electric-vehicle-charging-station-opens

maintenance system is yet to be established as EVs are just penetrating the market. Workshops will need to be well equipped with quality tools and skilled human resources.

End-of-life phase

Recycling: A study[39] suggests that recycled batteries can contribute to more than 50% of the lithium, cobalt and other major materials needed in 2040. Recycling lithium-ion batteries are more complicated and riskier than lead-acid batteries. As transportation of the used batteries tentatively amounts to more than 40% of recycling cost,[40] establishing a plant within the country can be cheaper. The task of recycling is, however, very arduous and costly. Options will need to be explored as this is a complex issue worldwide.

Waste: Currently, Nepal is poor at waste management. Most battery wastes are either disposed of into landfills or sold in the informal market, ultimately landing in India for further recycling. Battery free electric vehicles such as trolley buses and trains could help reduce the battery waste.

Renewable Energy Storage: Companies in different countries, as an initiative, are exploring the use of replaced or removed batteries as a second life. It is estimated that used car batteries can be employed in grid power storage for more than ten years. After the batteries lose a certain range and might not be viable for mobility, they could be taken to solar farms and store the power for nighttime supply, thus supporting the grid.

[39] https://pubs.acs.org/doi/10.1021/acs.est.0c07030#
[40] https://www.sciencedirect.com/science/article/pii/S0921344921003645

4. BARRIERS

Through stakeholder consultations and literature review, a barrier analysis was conducted to identify barriers for electric public transport. National and international government documents, available data, research papers, outlooks, and other relevant publications were reviewed. A consulted stakeholders' list and the questions that guided the consultation are listed as Annex I and II. Barriers in terms of the core components as a whole and the governing factors are as follows.

Electric Public Transport Life Cycle

- **Public transport operators are largely informal and unable to access financing for vehicles** - In the operation sphere, the company model for public vehicle operation has been practiced as more like affiliations than ownership in most cases. Several vehicle owners jointly register as one company and that company acts only as a face to show that the operators are abiding by the law. The companies do not keep the accounts, do not show liability, and the operators are still working conventionally. Several small-scale public vehicle operators limited to one vehicle ownership make it difficult for GoN to formalize the sector. It, in turn, makes it harder for financial institutions to lend to transport operators.
- **The high upfront cost of electric buses deters operators from opting for alternatives to ICE vehicles** - Although the long-term costs of electric buses are lower, the huge upfront cost becomes a hurdle. Besides the upfront cost, the price for battery replacement as well is excessive. Lack of local manufacturing or assembly contributes to that massive price. 100% of the Electric vehicles, batteries and related charging equipment are imported from neighboring countries.
- **Limited availability of land required for charging of electric buses in cities** - Besides installation costs, vehicles will require a dedicated area for charging and all operators will not be able to manage lands themselves. It is a barrier to transport companies owning large fleets of buses that are willing to switch to electric vehicles.
- **Vehicle and battery waste could pose a challenge in the future without waste recycling mechanisms in place in the country -** With the proliferation of electric vehicles, waste management will be a large challenge. Government institutions and the private sector are wary of this but due to limited action in terms of policy and plans related to waste management, it is not easy for operators to switch to electric vehicles.
- **High cost of manufacturing electric vehicles within the country –** Although small electric vehicle companies are exploring opportunities to manufacture EVs within the country, the high cost of import of spare parts, due to high taxation is a deterrent to implementing EV manufacturing units in the country.

Policy Barriers

- **Most policies and other government documents lack tangibility and clarity -** For example, there is also inconsistency regarding incentives. The 2016/17 budget reduced customs duty on public and private EVs from 30% to 1% and 10% respectively. The excise duty was exempted and road tax was only 4%. However, the duties and tax were raised in the 2020/21 budget and again leveled down in 2021/22. These frequent changes can bring skepticism towards owning EVs among consumers. Furthermore, although there is 1% customs duty for public vehicles, there is an additional 13% VAT and 5% tax which

can drastically increase the price of already expensive buses as seen in the case of 20 electric buses being imported by Sundar Yatayat.[41]

- **Some policies are comprehensive but yet to be implemented -** For instance, the Environment-Friendly Vehicle and Transport Policy, (2014) is taken as a comprehensive and farsighted document, however, it has yet to come into action. There is lack of adequate plans, programs, strategies, and budgets for implementation.
- **Lack regulation and standards for EVs** - There is no policy guidance such as standards, regulating and monitoring mechanism, and delegation of authority for charging infrastructure, testing, and vehicle repair and maintenance. It results in an ad hoc operation of the ecosystem. The cases of failures, disasters, loss of investment will rise due to this.
- **Lack of policy to support conversion of ICE vehicles to EVs** - The Motor Vehicles and Transport Management Rules, 1997 bars the conversion on ICE vehicles to EVs[42]. Until that is revised or a new government regulation is formed that changes this case, the conversion option will be in deadlock.
- **Policies on transport yet to integrate considerations on gender and marginalized groups** - Although government documents are increasingly incorporating social aspects, policies on transport still do not address the specific needs of different genders and marginalized groups.
- **Lack of coordination among government bodies leading to poor implementation** - Different ministries and governments have been working in silos and their works have overlapped. There is a provision for forming the environment-friendly vehicle and transport working committees in the Environment-Friendly Vehicle and Transport Policy, 2014. However, it is unclear how this will fit in the federal structure established in 2015. Jurisdictions of local, provincial, and federal governments are not clear in the policies before prepared before 2015.

Financing Barriers

- **Operators discouraged by high CAPEX requirements of EVs** - High upfront cost of the electric vehicles, compared to the diesel counterparts, is a major challenge in the country. Although EVs have lower maintenance and operation costs, public transport operators willing to purchase electric vehicles get discouraged by the high capex requirements. The Budget 2021/22 reduced customs and road tax and exempted the excise duty for electric vehicles. That, however, has not been effective, more so for public vehicles. Diesel buses of greater than 40 passenger capacity are already incentivized as the custom duty for them is only 5% whereas for general ICE public vehicles, it is 80%. This has made electric buses' price nearly three times more expensive.
- **Limited focused investment on electric vehicles from local governments** - The federal government, Bagmati Province, Kathmandu Metropolitan City (KMC), and the

[41] https://www.nepalitimes.com/latest/nepal-goes-electric-but-conditions-apply/

[42] Motor Vehicles and Transport Management Rules, 1997. Available at: https://www.lawcommission.gov.np/en/wp-content/uploads/2018/09/motor-vehicles-and-transport-management-rules-2054-1997.pdf

Lalitpur Metropolitan City (LMC) have supported Sajha Yatayat to procure electric buses[43]. The 40 buses being imported are part of a USD 26 million fund provided by the federal government. These are notable initiatives; however, they are not structured decisions made based on strategic plans. Without a strategic plans, larger impact would not be possible. There is a Sustainable Urban Transport Fund in TDF which can be used for financing sustainable transport initiatives however, the fund size is small and would need linkage with government's fund for large scale work which is yet to happen.

- **Lack of trust of local financial institutions on public transport operators** - When public vehicle operators are still running in the conventional mode, financial institutions are cautious because of past experiences where ownership of vehicles has been transferred from one individual to another, increasing default risks.
- **Lack of land for charging stations** - Besides the cost of vehicles, establishing charging stations also entail a huge investment. The setups are expensive, and charging spaces require a certain amount of dedicated land that all operators might not possess or acquire.
- **Significant impact of COVID19 restrictions on the transport sector** - The COVID19 pandemic has highly impacted the public vehicle sector. While the operators are recovering from the crisis, it will be difficult to electrify their fleets with the fluctuating liquidity and market barreirs.

Resources

- **Lack of skilled manpower required for maintenance and repair of electric vehicles** - In terms of human resources, there is a lack of skilled personnel in the country. The university and diploma courses do not incorporate the knowledge required for the electric public vehicle ecosystem aptly.
- **Limited space and knowledge for development of innovative business models for EVs** - The nascent electric mobility sector demands innovations that can help the transition become cost-effective and bring solutions to pertaining hurdles in the country. For that, the space for innovation is limited in Nepal. There are limited incubation mechanisms and agencies for startups and a lack of promotion.
- **Limited skill and knowledge transfer to potential female operators** - The transport sector is primarily owned and operated by males, with limited provisions for female participation. Studies show that the relative concentration of women's employment in the transport, storage, and communication sectors is lowest in developing countries like Nepal.

Knowledge Barriers

- **Lack of MRV in the transport sector resulting in absence of evidence-based policy and project decisions** - Nepal overall lacks robust monitoring, reporting and verification systems and the case is similar in the transport sector. For instance, the database on public transport is poorly managed; several data are still not digitized and have limited accessibility. With the lack of data, it is difficult to generate evidence that aids the

[43] Technical and Investment Analytics for Sajha Yatayat's First Electric Bus Fleet. Availabe at: https://gggi.org/site/assets/uploads/2021/07/GGGI-2020-Going-Green_Electric-Bus-Fleet-Feasibility-Study.pdf

sustainable development of transport. For instance, due to a poor database, the emissions inventory in the Third National Communication Report submitted in 2021 is based on ten-year-old data.

- **Limited research on the public electric vehicle ecosystem** - The government separates a negligible amount of budget in research and a private sector rarely mobilizes funds for such activities. Evidence-based policy and activities in the sector are crutial for the effective deployment of electric vehicles in the country.

5. STRATEGIC ACTIONS

To overcome the existing and possible barriers to achieving a sustainable electric public vehicle ecosystem, stakeholders need to take strategic actions in their own domain and come together to solve intersecting issues. These actions have been developed through intensive interaction with key stakeholders, including MoPIT. The proposed actions have been grouped into five governance categories and aim to address the identified barriers. Proposed actions are outlined below, along with the stakeholders responsible for each activity.

5.1 Electric Public Vehicle Life Cycle

Strategic Actions	Responsible Stakeholders
Make provisions for the availability of government lands to establish bus depots in coordination with the local government. Expand the charging station networks strategically.	MoEWRI, NEA, Local governments
Explore business models for sustainable public transport operations. The cooperative model of Sajha Yatayat is a successful approach.	Private sector
Explore options for establishing battery and vehicle assembly plants to reduce costs of ownership.	MoF, NPC
Expand public vehicle networks by focusing on disadvantaged groups' needs and connectivity for seamless mobility. For that, build supportive infrastructure and make strict rules.	DoTM, PTOMB, Local governments, Private sectors
Explore and promote alternative technologies such as hybrid vehicles, trolleybuses, supercapacitors, and green hydrogen based on their feasibility to create a sustainable transport mix.	MoEST, MoPIT, Universities
Initiate pilot activities on electric public transport as promotion and demonstration. Introduce electric buses in identified routes and expand the coverage and quantity of buses based on the pilot experience.	MoPIT, DoTM, Local governments
Explore options for the second life of used batteries, recycling and safe disposal	MoEWRI, Private sectors, Local government

5.2 Policy

Strategic Actions	Responsible Stakeholders
Form an EV promotion committee, constituting members of government bodies, private sectors, academicians, and CSOs. Designate one of the staff as in charge of EV promotion. This committee will support the ministry in devising policies and plans of actions.	MoPIT
Establish a dedicated authority for the EV charging ecosystem within NEA which will work on setting standards, conducting research, making plans, setting charging regulations, setting tariff for EVs and technical specifications, pricing, data privacy, and monitoring.	MoEWRI, NEA
Improve the vertical and horizontal coordination among government bodies with joint effort to prevent silos, redundancy, and duplication of working areas. Explore the appropriate platform for discussion on electric transport.	Inter-Ministerial Coordination Committee on Climate Change (IMCCCC),

	Inter-Provincial Coordination Committee,
Support the local level government in preparing local government plans and budgets. Also support them to ensure gender equality and social inclusion in its public transport system through those plans and budgets.	Multilateral/Bilateral International Agencies, NGOs, DoTM, Federal and Provincial government
Explore options to fit small operators in the company model or to qualify only a single company to operate in a route through competitive bidding and let it operate for a set time. Also, clearly categorize ride-sharing vehicles and explore options to decarbonize them with support from other stakeholders.	DoTM
Develop standards for vehicle and parts testing, repair and maintenance, and vehicle and battery assembly to ensure quality and safety in electric public transport operation.	DoTM
Revise the Vehicle Transport and Management Act and Rules and form regulations for promoting ICE vehicles to EV conversion.	DoTM
Revise tax incentive provisions to further reduce the cost of electric public vehicles for early adoption. The partial exemption of custom duty on ICE buses could be gradually phased out or shifted to other forms of incentive for electric buses.	MoF
Consider providing incentives through schemes to encourage private sectors to import batteries and other EV components in large units as well as for in country assembly and manufacturing.	MoF
Mainstream gender equality and social inclusion in transport policies and implement activities to increase women and disadvantaged group's access to ownership and operation of public electric vehicles.	Ministry of Women, Children and Social Welfare, MoPIT

5.3 Financing

Strategic Actions	**Responsible Stakeholders**
Identify sustainable financing models for sustainability. Develop a direct subsidy program to encourage early adopters and identify an appropriate source of fund for that. The country could learn from effective schemes from other countries such as the FAME of India. The government of India initiated the FAME scheme in 2015 to support the uptake of electric vehicles in the country with a budget of INR 8.95 billion. This was later scaled up in 2019 with a budget of INR 100 billion and the scheme was titled FAME II. INR 85.96 billion would be used to support the upfront cost of purchasing EVs and INR 10 billion for establishing charging	MoF, TDF

infrastructures[44]. The demand incentive or the reduction in the upfront cost will be INR 10000 per kWh for EVs including hybrid vehicles except buses. For buses, it is higher at INR 20000 per kWh the intention being promotion of public transport. These support, however have to meet certain criteria to be eligible and there is also a set limit to the number of vehicles to be supported. As a support for setting up charging infrastructures, the scheme again promotes public vehicles. One of the provisions is to provide funding to the owner of electric bus with one slow charger for every bus and one fast charger per 10 buses. Overall, FAME's tangible and clearly set targets make it an effective scheme.	
Reduce interest on loans for EV procurements to encourage early adopters. Banks could be the focal point for this due to their experience in disbursing loans. Banks could be provided with a dedicated fund which they will lend out to eligible companies at a lower interest rate.	MoF, TDF, Private sector (financing institutions)
Enlarge the Sustainable Urban Transport Fund of TDF, which could finance sustainable transport initiatives. If the fund is adequate, TDF has a set mechanism to mobilize it. Prepare loan and grant policy documents that guide what sort of incentives will be provided and the structure of the loan grant component for the public transport sector.	MoF, TDF, MoPIT
Explore financing models such as PPP or blended finance to expand charging. Establish an entity for mobilizing the fund for building the charging station ecosystem.	NEA, TDF, private sectors
Develop incentives to prioritize the participation of women and disadvantaged groups in all levels of the transport sector value chain.	MoPIT, MOF, MoWCSW, Financial Institutions

5.4 Resources

Strategic Actions	**Responsible Stakeholders**
Train engineers and technicians to be skilled on vehicle conversion and EV repair and maintenance which are technically sensitive tasks.	Universities, Private sectors, NGOs, Associations
Explore options to incubate startups and to provide other supports in entrepreneurship.	Private sectors, Associations, NGOs
Ensure equal opportunity to employment and entrepreneurship of women and disadvantaged groups. Manage cheaper loans for enterprises led by women and members of disadvantaged groups.	Private sectors, MoF

[44] https://heavyindustries.gov.in/writereaddata/fame/famedepository/3-operational%20guidelines.pdf

5.5 Knowledge

Strategic Actions	Responsible Stakeholders
Make data digitalized, well managed, secured, and accessible. Information such as charging and vehicle operation data will help make evidence-based actions. Implement a robust MRV system for the transport sector to represent the impacts of electric vehicles accurately and to inform interventions in the transport sector	All ministries, DoTM, NEA, Private sectors, Universities
Support technical and socio-economic research for further understanding the gaps and opportunities in the public electric transport ecosystem.	International Agencies, MoEST, MoPIT, Private sectors
Build a center of excellence on electric mobility at academic institutions. These institutions will need to coordinate well with the central government. The government will assess its needs and attract and/or flow funds to universities and CBOs for research. Encourage university students to conduct studies on the issues of EVs pertaining to the country.	MoEST, Universities, MoPIT, DoTM, Private sectors
Strengthen the pedagogy on different aspects of the electric public vehicle ecosystem.	MoEST, Universities
Conduct detailed study through robust modelings and build integrated plans for expanding the electric public vehicle ecosystem.	Think Tanks, Private sector, PTOMB, Local governments

Annex I

List of experts and stakeholders consulted

S.N.	Name	Designation	Organization
1	Keshab Kumar Sharma	Joint Secretary	Ministry of Physical Infrastructure and Transport (MoPIT)
2	Bijukumar Shrestha	Joint Secretary	Nepal Planning Commission (NPC)
3	Rajesh Babu Ghimire	Program Director	NPC
4	Abhishek Karki	EV/Mechanical Engineer	Kathmandu University (KU)/Abhiyantri Karmashala
5	Prashanta Khanal	Sustainable Urban Transport Practitioner	
6	Jagadish Dhungana	Executive Director	Province Transportation Operation and Management Board (PTOMB)
7	Amrit Nakarmi	Department Coordinator	Center for Energy Studies IOE, TU
8	Bijaya Man Sherchan	Executive Chairman	Pashupati Energy Development Company
9	Krishna Prasad Sapkota	Executive Director	Town Development Fund (TDF)
10	Shuva Raj Neupane	Senior Division Engineer	MoPIT
11	Suresh Poudel	Senior Division Engineer	MoPIT
12	Ram Chandra Poudel	Director	Department of Transport Management (DoTM)
13	Shankar Singh Dhami	Senior Division Engineer	MoPIT
14	Surendra Govinda Joshi	Technical Advisor	Lalitput Metropolitan City (LMC)
15	Saroj Kumar Pradhan	Technical Advisor	NRSC
16	Piyush Chataut	Engineer	MoPIT
17	Prakash Poudel	Engineer	MoPIT
18	Anantaa Pandey	Officer	GGGI
19	Bhushan Tuladhar	Consultant; Board Member	Climate Analystics; Sajha Yatayat
20	Saroj Basnet	Vice Chairperson	City Planning Commission, KMC
21	Sagar Mani Gyawali	Project Manager	Electric Vehicle Charging Infrastructure Development Project, NEA

Annex II

Guiding questions for stakeholders' consultation

1. **Electric vehicle number and movement**
   - The growth in EVs' number largely depends on battery technology, charging infrastructures, and government incentives. What are the latest updates and development in these areas?
   - What are the reasons for not increasing public EVs Buses in Nepal despite favorable policies and incentives?

2. **Action plan with policy interventions required to promote public EVs**
   - What are the additional financial and non-financial incentives planned to promote EVs in Nepal?
   - What are the major reforms needed at the price of electricity, establishment & standardization of charging infrastructure?
   - What are the major challenges in converting fossil-fuel-based vehicles into electricity based?
   - What are the existing public transport business models and transport fleet renewal schemes in the city?

3. **Plan for supply of supplementary infrastructure**
   - What are the major challenges in setting charging stations for EVs?
   - What actions are required to encourage as well as meet the demand of increasing EV adoption?

4. **Policies and measures for air pollution control and vehicle emission control**
   - How do you think Nepal should support the climate agenda, and what role should the government and private sector play?
   - What are the policy gaps and barriers to the electrification of public transportation in Nepal?
   - What are the future plans of the government to reduce vehicular emissions?
   - Nepal comes under the category of high-risk countries because of its fragile geological formation, topographical diversity, sensitive ecosystems and variation in climate. What are the necessary steps taken to reduce these risks by curbing air pollution?
   - How do you find the current development initiatives by the government to promote EVs? (In terms of strategy, finance, action plan, coordination, collaboration etc.). Do you think they are sufficient to demonstrate the seriousness of the issues?
   - How do you think we can make the future of public transportation more inclusive?

ANNEX III

Tariff rates for three different schemes of transportation consumers

Tariff rate for medium voltage transportation consumers

Types	Demand Charge (Nrs. Per KVA / month)	Energy Charge (Nrs / kWh)
Medium Voltage (11 KV)		
Charging Station	230	5.60
Other transportation	255	8.80
Medium Voltage (33 KV)		
Charging Station	230	5.60
Other Transportation	255	8.60

ToD tariff rate for transportation consumers

Type	Demand Charge (Nrs. Per KVA / month)	Energy Charge (Nrs / kWh)		
		Peak time (17.00-23.00)	Off Peak Time (23.00-5.00)	Normal time (5.00-17.00)
Baisakh to Mangsir (Mid-April to Mid-November)				
Medium Voltage (33 KV)				
Charging Station	230.00	7.00	3.70	5.50
Other Transportation	255.00	9.35	3.70	8.40
Medium Voltage (11 KV)				
Charging Station	230.00	7.15	4.20	5.60
Other Transportation	255.00	9.65	4.20	8.50
Paush to Chaitra (Mid-December to Mid-March)				
Medium Voltage (33 KV)				
Charging Station	230.00	7.00	5.50	
Other Transportation	255.00	9.35	8.40	
Medium Voltage (11 KV)				
Charging Station	230.00	7.15	5.60	
Other Transportation	255.00	9.65	8.50	

ToD tariff rate for automatic swap card users (commercial service providers)

Type	Energy Charge (Nrs / kWh)		
	Peak time (17.00-23.00)	Off Peak Time (23.00-5.00)	Normal time (5.00-17.00)
Baisakh to Mangsir (Mid-April to Mid-November)			
Medium Voltage (33 KV)			
Charging Station	8.40	4.45	6.60
Other Transportation	11.20	4.45	10.10
Medium Voltage (11 KV)			
Charging Station	8.60	5.05	6.70

Other Transportation	11.60	5.05	10.20
Paush to Chaitra (Mid-December to Mid-March)			
Medium Voltage (33 KV)			
Charging Station	8.40	6.60	
Other Transportation	11.20	10.10	
Medium Voltage (11 KV)			
Charging Station	8.60	6.70	
Other Transportation	11.60	10.20	

ANNEX IV

Comparison of total cost of ownership of electric versus diesel bus conducted by GGGI

Cost component (NPR)	Bus models			
	Diesel (Viking)	Electric (BYD K7)	Electric (BYD K9)	Electric (Ashok Leyland Circuit)
Acquisition cost	3,198,345	23,104,100	30,618,500	42,738,500
Lifetime fuel cost	13,087,901	2,861,036	2,861,036	2,861,036
Lifetime maintenance cost	6,576,587	3,288,293	3,288,293	3,288,293
Economic cost	10,393,303	-	-	-
Social cost	11,723,683	-	-	-
Environmental cost	3,338,927	-	-	-
Total (NPR)	48,318,746	29,253,429	36,767,829	48,887,829

(source: Deploying Electric Buses in the Kathmandu Valley: A Pre-Feasibility Study)