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Electrification of the Transportation Sector in Nepal: Economic Potential and Fiscal Challenges






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Abstract

Transport sector is central to Nepal's economic and energy systems but is also a major source of fiscal and environmental vulnerability. The sector facilitates over 90% of the movement of passengers and goods but remains overwhelmingly dependent on imported petroleum products, which accounts for nearly one-fifth of the national import bill. The Third Nationally Determined Contribution (NDC 3.0) represents a strategic policy shift towards electrification of transport sector, leveraging Nepal's surplus hydropower to reduce fossil-fuel dependence and promote low-carbon growth. Using IFPRI's dynamic Computable General Equilibrium (CGE) model calibrated to the 2022 Nepal's Social Accounting Matrix, two scenarios were simulated: a Business-as-Usual path and an Electric Vehicle (EV) transition aligned with NDC 3.0 targets. Results show that successful electrification could make Nepal's economy 1.4% larger by 2035, generating about 10,000 jobs, and lifting around 9,000 people out of poverty. However, fiscal analysis reveals substantial revenue and foreign-exchange pressures, with EV imports in FY 2023/24 alone leading to a revenue shortfall of NPR 15.59 billion due to lower import tariffs and a forex burden of NPR 17.07 billion. The findings highlight that while electrification of transport sector can drive sustainable growth and resilience, its economic promise depends on coherent fiscal reform and policy coordination to prevent revenue erosion and ensure a just, inclusive transition.

Key Messages

- **High economic stakes:** The transport sector drives over 90% of national mobility and contributes significantly to GDP but remains a key source of trade deficit and pollution due to its heavy dependence on imported fuels.
- **Economic gains from increased electrification of transport:** CGE simulations indicate that achieving NDC 3.0 targets could make GDP 1.4% higher by 2035, create 10,000 jobs, and reduce poverty for 9,200 people.
- **Fiscal risks are immediate:** EV imports have already caused a NPR 15.59 billion revenue shortfall and NPR 17.07 billion forex burden in FY 2023/24, reflecting long-term structural fiscal challenges.
- **Balancing Growth and Revenue:** The transition's success depends on timely fiscal reform, prioritizing public transport electrification, and developing new, equitable revenue instruments.

1. Introduction

The transport sector is vital for the Nepalese economy, facilitating movement of over 90% of passengers and goods (Asian Development Bank, 2018). It accounts for about 10.5% of the nation's total energy use, with diesel (60.3%) powering freight and heavy passenger vehicles and petrol (31.6%) used mainly by private vehicles (WECS, 2024).

Given its heavy reliance on imported petroleum products, the sector has both economic and environmental implications. In FY 2022/23, fuel imports alone made up 17.3% of Nepal's total import bill (Khanal & Rajbhandari, 2025), significantly widening the trade deficit and increasing vulnerability to volatile global oil prices.

Nepal's transport sector is also a major contributor to air pollution and green house gas (GHG) emissions. In 2022, it emitted about 4,762 Gg of GHGs, 19% of total emissions from fuel combustion (MoFE, 2025). Freight transport, particularly trucks, is the largest single source, contributing 29% of transport-related CO_2 emissions despite representing only 10% of the vehicle fleet (MoFE, 2021). These emissions exacerbate urban air pollution and pose serious public health risks, including increased cardiorespiratory diseases (Adhikari et al., 2023).

Despite rapid fleet expansion, transport-sector productivity has lagged. While the Gross Value Added (GVA) of transportation grew by 31% between 2012/13 and 2022/23, its share in GDP fell from 5.3% to 4.8% (National Statistics Office, 2023). Vehicle numbers surged from under one million in 2000 to 4.9 million in 2022, yet the GDP contributed per vehicle declined by 61% over the same period (NRB, 2023). This decline reflects an imbalance between vehicle growth and their productive use. Vehicle growth is largely driven by rising imports of private vehicles rather than commercial or industrial transport. Weak linkages between the transport, industrial, and agricultural sectors, along with high fuel costs, further constrain the sector's economic contribution.

Despite the continued dominance of fossil fuels in Nepal's transport sector, initial signs of change are emerging as electricity use, though still very small, has begun to increase. Between 2019 and 2023, diesel and petrol accounted for 88–93% of total transport energy consumption, while electricity contributed less than 0.05% (WECS, 2024). From 2022 to 2023, diesel and petrol consumption declined by about 25% and 11% respectively, while electricity use in transport more than doubled (WECS, 2024).

Recognizing the above challenges, the Government of Nepal's Nationally Determined Contribution (NDC) 3.0 outlines an ambitious plan to accelerate transport electrification. Leveraging Nepal's abundant hydropower resources, the strategy aims to reduce fuel imports, enhance energy security, and lower emissions overall. This policy note examines the potential economic impacts of transport electrification as prioritized in NDC 3.0 using a Computable General Equilibrium (CGE) model to assess how this transition could influence Nepal's economy.

2. Policy Landscape of Transport Sector and Nationally Determined Contributions 3.0 of Nepal

Nepal's transport policy has evolved from general ambition to measurable targets under NDC 3.0. The National Transport Policy of 2010 acknowledged the need for cleaner mobility but lacked specific goals (Giri et al., 2019). In the years that followed, poradic tax

incentives for electric vehicles were introduced and later withdrawn, creating uncertainty for investors.

The submission of Nepal's Third Nationally Determined Contribution to the United Nations Framework Convention on Climate Change (UNFCCC) marks a turning point. The policy aligns closely with Nepal's expanding hydro power capacity, which is expected to generate surplus electricity, particularly during monsoon months (Bhandari & Subedi, 2023). Redirecting this renewable power to transport aims to reduce imported fuel dependence, and create productive use of domestic resources.

To translate this policy vision into measurable action, NDC 3.0 defines clear quantitative targets for vehicle electrification and transport-infrastructure expansion.

Key NDC 3.0 Transport Targets (2030–2035)

- **Impetus to Battery Electric Vehicles (BEVs):** NDC 3.0 seeks to raise the share of BEVs to 90–95% for private passenger vehicles, 70–90% for public four-wheeler, and 10–20% for freight and waste-collection vehicles by 2030–2035. As of 2023, BEVs represented 12.4% of private sales and 29% of public four-wheeler sales, reflecting gradual progress toward these goals.
- **Improved Public Transport Systems:** The plan envisions developing 50 km of integrated electric bus, trolley, and light-rail networks by 2030, expanding to 100 km by 2035 in the Kathmandu Valley.
- **Expansion of Electric Rail Connectivity:** To strengthen intercity and freight movement, NDC 3.0 targets 200 km of electric rail by 2030 and 300 km by 2035. Currently, only 52 km of diesel-electric rail is operational, with 112 km of trackbed laid.

3. Nepal's Transport Sector's Future: Economy-wide Effects- Methodology and Results

We employ an economywide model for Nepal to assess the impact of successful completion of NDC 3.0 targets. IFPRI's dynamic computable general equilibrium (CGE) model (Thurlow, (2008), which is calibrated to a recent Social Accounting Matrix (SAM) of Nepal has been used to measure the impact on Nepal's economy (IFPRI, 2024).

Table 1: Vehicle Fleet Projections for 2035

Parameter	Business-as-Usual (BAU) Scenario	Electric Vehicle (EV) Scenario
Annual Vehicle Addition	285,000	285,000
Total Vehicle Fleet (2035)	8.6 million	8.6 million
Total Electric Vehicles (EVs) [2035]	0.25 million	1.52 million
EV Share of Fleet	2.90%	17.60%

Source: Authors' estimates

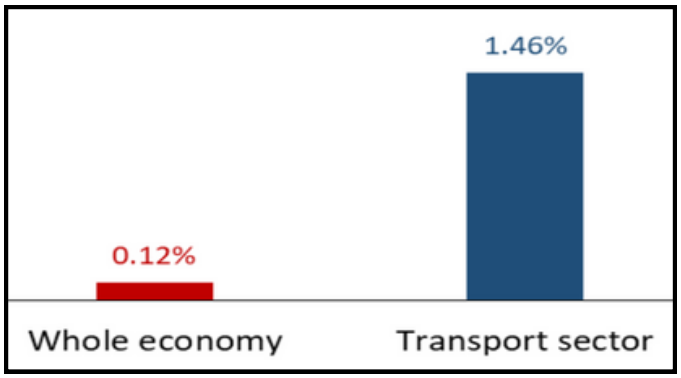
Using this model, we run 2 scenarios as depicted in Table 1 with following description:

- **Business-as-Usual (BAU) Scenario:** This scenario assumes current trends continue without any new major policy. The vehicle fleet keeps growing at the current rate of about 285,000 new vehicles per year. By 2035, this would result in a total of 8.6 million vehicles on the road. Under this scenario, electric vehicle (EV) adoption continues slowly, reaching only 0.25 million vehicles, or just 2.9% of the total fleet.
- **Electric Vehicle (EV) Scenario:** This scenario models the successful achievement of the government's electrification targets. The total number of vehicles still reach 8.6 million by 2035, but the mix of vehicles changes dramatically. Following the NDC 3.0 targets, EVs make up 90% of new passenger vehicle sales and 20% of new light freight vehicle sales by 2035. This results in a total of 1.52 million EVs on the road, representing 17.6% of the entire fleet.

These scenarios present two future pathways: continuing the current path (BAU) locks Nepal into a future of high fossil fuel use, and a transformative, partially electrified future (that is, more EV under NDC 3.0) that sets the stage for long-term decarbonization.

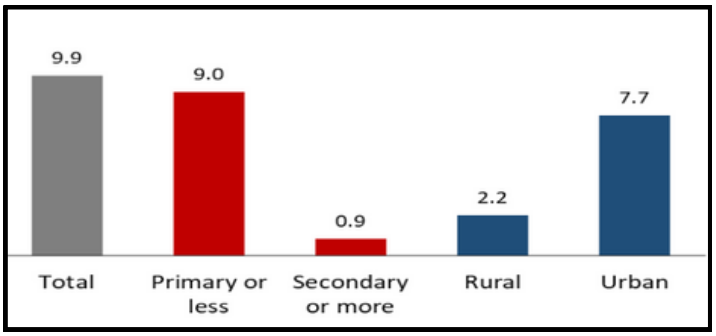
The simulation outcomes are reported in Figures 1-3. Figure 1 highlights the contrast between the two scenarios, showing that electrification delivers stronger economic performance than continued reliance on fossil fuels. Under the EV scenario, the transition to electric vehicles increases the transport sector GDP by 1.5 percent per year through 2035. Since transport is an essential input across all sectors of the economy, overall GDP growth rises by 0.12 percentage points per year, resulting in an economy that is 1.4 percent larger by 2035 compared to the baseline scenario. This result suggests that even modest efficiency gains from reduced fossil fuel imports through EV promotion under NDC 3.0 yield significant economic dividends. Further, under EV scenario, around 10,000 new jobs are created by 2035 mainly for the lower-educated workers in cities and towns (Figure 2).

Figure 1: Percentage change in GDP from BAU scenario in 2035



Source: Results based on model simulations

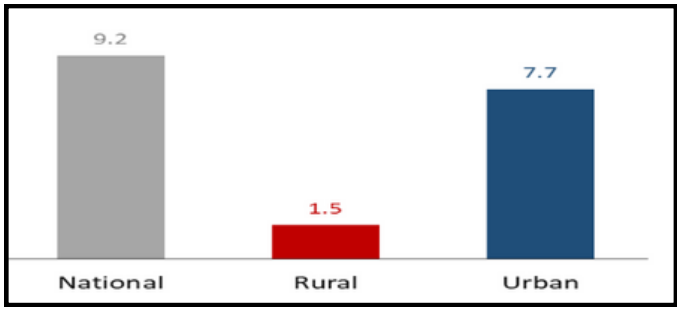
Figure 2: Change in the number of employed people (Workers in thousands by 2035)



Source: Results based on model simulations

Meeting the NDC 3.0 targets lowers transportation costs. This boosts household incomes, leading to a 1% increase above the baseline by 2035. The income gains from these transport improvements are consistent across all household groups, varying from 0.9% to 1%, and helping roughly 9,200 individuals surpass the international poverty threshold ($2.15/day) (Figure 3).

Figure 3: People Lifted out of Poverty (Thousand people, $2.15 a day poverty line)



Source: Results based on model simulations

4. Caveat

This note is based on the ongoing collaborative research work, and the model assumptions are made based on the series of expert consultation meetings held in Kathmandu in February and May 2025. The analysis represents a first order assessment of the economywide impact of electrification of transport sector in Nepal. As the research progresses, the analysis will include various policy trade-offs to accomplish NDC 3.0 target for transport sector.

5. Challenges

1. Balancing fiscal health and sustainable growth:

Our analysis of financial data reveals significant fiscal risks in the transport transition. Taxes on petroleum products have long been one of the government's most stable and substantial revenue sources (IIDS, 2024). As the country replaces fuel with electricity, this pillar of revenue weakens, creating a complex policy challenge between pursuing sustainable growth and maintaining fiscal health.

- Immediate Revenue Loss: In FY 2023/24, imports of 11,700 EVs led to an estimated revenue shortfall of NPR 15.59 billion compared to equivalent ICE vehicles (IIDS, 2024). The loss stems from lower import duties on EVs and the absence of future fuel-tax revenue.
- Long-Term Structural Gap: Each ICE vehicle generates about NPR 1.125 million in lifetime fuel taxes (IIDS, 2024). Broad EV adoption under NDC 3.0 would therefore create a persistent annual revenue deficit of tens of billions of rupees.
- Foreign-Exchange Pressure: The high upfront cost of EV imports added an estimated NPR 17.07 billion forex burden in FY 2023/24, while savings from reduced fuel imports will accrue only gradually (IIDS, 2024).

2. Ambitious targets: Electric vehicle (EV) penetration, while growing, remains nascent. As of 2022/23, EVs constituted just 1% of the total vehicle fleet, highlighting a significant gap between current reality and national targets (MoFE, 2021).

6. Conclusion

The electrification of Nepal's transport sector under NDC 3.0 represents an economic opportunity. The CGE modeling results demonstrated that successful implementation would expand the economy, boost employment, and reduce poverty through lower fuel imports and improved energy efficiency. However, this transition will put downward pressure on governments revenue and on foreign exchange reserves.

The sustainability of the transition thus rests on the government's ability to manage these trade-offs: pursuing decarbonization while preserving fiscal stability. The path forward requires a phased, well-coordinated strategy that couples electrification with fiscal innovation, public investment, and social equity.

7. Policy Recommendations

To accelerate electric vehicle (EV) adoption, protect government revenue, and ensure a just transition, the following integrated actions are recommended:

1. Adopt a Targeted, Revenue-Smart Fiscal Transition:
Implement a step-by-step fiscal plan to accelerate EV adoption while safeguarding government revenue. In the short term, replace broad EV tax breaks with targeted support for vehicles that deliver the greatest public benefit: electric buses, minibuses, two-wheelers and three-wheelers, and high-use commercial fleets.

2. Finance EV Incentives with a Revenue-Neutral Bonus-Malus (Feebate) System:
Establish a self-financing mechanism by imposing higher taxes or fees (a "malus") on high-polluting, high-engine-capacity, luxury, and very large internal combustion engine vehicles at import or registration. The revenue generated would directly fund rebates or tax reductions (a "bonus") for the priority of EV categories. This system accelerates electrification without creating a fiscal burden, while actively discouraging the most polluting vehicle imports.

3. Eliminate Contradictory Fossil Fuel Infrastructure Investments:
Improve policy coherence by mandating alignment between the Ministries of Transport, Energy, and Finance to stop self-defeating spending. A critical example is halting the expansion of fossil-fuel infrastructure, such as new fuel depots or pipelines that assume long-term diesel demand, while simultaneously investing in EV charging networks and electricity grid upgrades for transport.

4. Advance an Equitable Transition:
Design subsidy and taxation frameworks, particularly within the feebate system, to prioritize access for low- and middle-income groups. This ensures the benefits of electrification, such as lower operating costs and cleaner air are broadly shared and does not entrench transport inequality.

5. Promote Public Transport to Maximize Domestic Value:
Direct investment toward electric and high-capacity public transport systems to reduce fossil fuel dependence. Couple this with policies that incentivize local assembly, maintenance, and smart technology integration. This dual focus will create skilled jobs, foster digital innovation, and build a resilient industrial ecosystem for sustainable long-term growth.

8. Acknowledgement

The IIDS-IFPRI project focuses on integrating agrifood systems into climate and development policies ahead of COP30 in Brazil (2025). Furthermore, the study aims to provide model-based analysis to support Nepal's government in areas such as low-carbon agricultural

technologies, sustainable energy transition, and transport sector mitigation strategies. It will also assess the macroeconomic impact of climate policies, financing options for low-carbon development, and socioeconomic risks of transition. Key activities include workshops with policymakers, sectorial diagnostics, economy-wide modeling, and a final report to be completed by March 2026. Finally, the study seeks to enhance Nepal's food security, resilience, and environmental sustainability.

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