

Case Study

Enabling Adoption of Electric Mobility in Public Transportation in India

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Contents

01 Summary	2
02 Context.....	4
03 Approach.....	5
04 Outcomes	6
05 Lessons	7

01 Summary

India is on track to become the third largest road transportation market in the world by 2020, driven by strong economic growth and rapid urbanization. In the next twenty years, steady economic growth, a higher working population, and longer travel times resulting from urban sprawl are expected to lead to a four-fold increase in the demand for urban transport, nearly tripling the demand for passenger transport as a whole. The growth of India's transportation sector has resulted in higher oil imports (in a country where more than 75 percent of oil is imported), higher greenhouse gas (GHG) and particulate matter (PM10 and PM2.5) emissions, increased noise pollution, and increased congestion.

Himachal Pradesh (HP), a hill state in North India, has evolved rapidly in terms of economic growth and holds the promise of considerable progress owing to its rich natural resource base. However, at the same time, HP is confronted with mobility related challenges, such as the growing number of private vehicles and an influx of tourists. These challenges are increasingly resulting in adverse impacts on the fragile Himalayan ecology. The State is now experiencing acute problems related to congestion and parking, as well as last mile connectivity due to its mountainous terrain.

Electric mobility is a sustainable solution for the future that has the potential to enhance India's national energy security and contribute to green economic growth by reducing pollutants and dependence on fossil fuels. Electric buses provide a particularly compelling mobility option which can address increasing transportation needs and congestion problems while providing environmentally friendly, high quality transport. Electric buses offer several advantages over diesel and compressed natural gas (CNG) buses in the mountainous terrain of HP. Although electric buses have higher upfront costs than conventional vehicles, they can provide similar and even superior technical performance with substantially lower operating costs. Electric buses generate reduced GHG emissions and no local air pollution, lessen congestion, noise, and contribute to multiple

sustainability co-benefits, such as reduced driver fatigue, increased road safety, transport affordability for the poor, etc.

Domestic manufacturing of electric buses in the state will support the economy through direct and indirect job creation in allied and ancillary industries.

GGGI has supported the State Government of Himachal Pradesh in developing and implementing its Green Growth Strategy and established a business case for introduction of electric vehicles, a first in the country. GGGI also supported the state with a pre-feasibility assessment for deployment of battery powered electric buses for public transport, with a focus on technical, environmental, and socio-economic relevance.

The proposal, developed by GGGI and the Government of Himachal Pradesh, became the first successful initiative by any state government in India to receive a national grant for electric buses. The Government of India approved a USD 5.5 million grant to HP to procure 25 electric buses under the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles (FAME) program.

Sectors in Focus

Energy, Green Cities

Key Challenges

Electric mobility in public transport can address challenges related to growth in sustainable transport, national energy security, air and noise pollution, and GHG mitigation.

Impacts

Environmental: Electric buses will lead to environmental sustainability since they have zero tail pipe emissions and 30 percent lower noise levels. By harnessing hydropower to charge electric buses, the state is effectively substituting fossil fuel consumption with clean energy.

Social: Electric buses can help in improving the affordability of transport for the poor by optimizing operating costs and facilitating access to key services (e.g., health, education, etc.), and inclusive development.

Economic: By lowering energy consumption, due to dependence on electricity generated through hydroelectric power sources, electric buses can reduce dependence on fuel imports into the state, and thus strengthen energy security. Electric vehicles can also create new opportunities for earning income through local manufacturing, and direct and indirect job creation in allied and ancillary industries.

Keywords

Eco-industrial estate, Green industries, Eco-industrial town, Industrial ecology, Sustainable industrial zone development, Stakeholder engagement

Geographic Coverage Himachal Pradesh, India



02 Context

Himachal Pradesh (HP) is a mountainous state in Northwestern India that has demonstrated rapid economic growth and promises continued progress owing to considerable natural resources, including hydropower, horticulture, forestry, and watershed management. However, at the same time, HP is confronted with a variety of transportation challenges. The State is experiencing a rapid increase (about 10 percent per year) in the number of private vehicles being registered. HP is also experiencing a growing influx of tourists, both domestic and foreign, causing surges in traffic, longer travel times, and associated adverse impacts on the environment, including air and noise pollution and increased greenhouse gas (GHG) emissions. HP faces acute problems of parking, congestion, and last-mile connectivity due to its highly mountainous terrain. Moreover, the state-owned Himachal Road Transport Corporation (HRTC) faces significant operational challenges due to fuel price volatility and higher bus fleet maintenance costs compared with buses operating in the plains areas, impacting state finances.

Electric mobility provides an environmentally friendly solution to increasing transportation needs and can enhance national energy security and contribute to environmental sustainability by reducing pollutants

and dependence on fossil fuels. The Government of India has launched several initiatives to promote electric mobility in India through various policies and programs. The National Electric Mobility Mission Plan (NEMMP) 2020 sets out a roadmap for electric mobility in the country. With the FAME scheme, launched under the NEMMP 2020, the Government aims to provide fiscal and monetary incentives to promote early adoption and market creation for hybrid and electric vehicles. Taking technology, cost, infrastructure, and financing considerations into account, electric buses for public transport are best positioned to lead the transition to electric vehicles.

The HP State Government and GGGI jointly developed a Green Growth Strategy in 2015 and identified public transport as a key growth engine capable of providing both economic and environmental benefits. GGGI conducted a detailed assessment, with inputs from HRTC, the State Administration, the Himachal Pradesh Tourism Development Corporation (HPTDC), the Himachal Pradesh State Electricity Board (HPSEB), and civil society. The assessment concluded that HP is uniquely positioned to replace diesel, petrol, and CNG vehicles with electric vehicles powered by clean hydropower, due to the advantages of the geophysical conditions in HP.

03 Approach

GGGI supported the State Government of Himachal Pradesh to develop a Green Growth Strategy, which identified transport sector as a key green growth opportunity, capable of impacting both economy and environment.

GGGI conducted a techno-economic feasibility assessment on the impacts of deploying electric buses in Himachal Pradesh versus continued reliance on conventional diesel and CNG buses. The assessment built a case for the applicability of electric mobility in the state analyzing the requirements for deployment and eventually formulating financing opportunities for electric buses using the following approach:

- The assessment analyzed ways in which the capital cost of the electric buses could be optimized. This revealed that introducing non-air conditioned electric buses for intra-city routes would reduce air-conditioning and charging requirements, thus reducing the size of the battery which accounts for 50-60 percent of the total cost of the bus.
- Key cost components of bus ownership and management were identified and compared, using the Total Cost of Ownership (TCO) framework, which captures the cost incurred towards ownership and operation of a bus over its lifetime. The analyses indicated that switching to electric buses would reduce lifecycle maintenance cost by 85 percent compared with existing buses, when both direct as well as indirect costs for diesel buses undergoing repair were considered. The TCO framework analysis also helped to identify the viability gap, or the difference between economic benefits and financial viability, in the cost of an electric bus over its lifetime as compared with a diesel bus.
- The assessment also identified ways to optimize the operating costs of electric buses. GGGI conducted the first-of-its-kind analysis in India to map electric bus charging requirements with run-of-the-river hydropower generation in HP. GGGI also proposed a tariff-based charging mechanism, which can potentially reduce electricity costs for charging by 90 percent.
- Based on the assessment, the analyses considered various options for project structuring to identify potential sources to fund the deployment of electric buses in the state, such as through bus leasing. It also identified mechanisms to cover viability gap funding requirements, such as the FAME scheme.

The study involved extensive stakeholder consultations at different stages of the assessment. Senior officials of the HP State Administration, and in particular the Transport Department, helped identify fiscal, technical, and economic barriers to implementing electric buses despite its inclusion in the state's Transport Policy. HRTC provided key inputs including data about its fleet and operational strategy. The HPSEB provided information on the power scenario of the state. Additionally, the Border Roads Organization and tourism department were instrumental in providing useful inputs and facilitation at various levels.

04 Outcomes

Convinced by the innovative analyses employing a suite of tools, the HP Government submitted the proposal under the National Flagship Program on Electric Mobility. Based on the analysis and business case, the National Government agreed to finance 75 percent of the viability gap (approximately USD 5.5 million) to procure 25 electric buses under the FAME scheme.

The proposal became the first successful initiative by any state government in India to substitute Diesel buses with Battery Operated Electric Buses; powered by Hydropower.

Based on GGGI recommendations, the HP State Government announced a series of policy incentives in the state budget, including exemptions from the token tax, registration charges, and VAT on all electric vehicles for five years. The government is also considering to establish an exclusive, discounted electricity tariff for electric vehicles and removing tax barriers for promoting manufacturing electric vehicles in the state.

The first-mover advantage is expected to bring co-benefits to the state including green investments and jobs, while reducing congestion, environmental impacts, and carbon emissions.

- The analysis identified a strong business case for the introduction of electric buses in HP. Key enabling factors included the following:

TCO analysis shows that electric buses are expensive when compared to ICE buses; however, they offer several economic and green growth benefits when compared to the latter;

- Electric buses offer advantages over diesel and CNG buses in the context of the hilly terrain of HP. They deliver superior torque to power output at low speeds, enable regenerative braking mechanism, and have lower wear-and-tear due to elimination of mechanical drive train, leading to lower operational and maintenance costs for HRTC;
- Electric buses can significantly benefit environmental quality of the State since they have zero tail pipe emissions, lowering pollution and GHG emissions, and 30 percent lower noise levels;
- They also reduce drivers' fatigue and increase road safety by shifting from the clutch gear systems of conventional buses to automatic drive in electric buses;
- Electric buses also help improve the affordability of transport for the poor by reducing user costs, and support direct and indirect job creation through local manufacturing.

While promoting higher energy security due to lower energy consumption and lower price volatility in electricity, electric buses can also help bring down fuel import bills for the state and significantly reducing the operating costs.

05 Lessons

The State of Himachal Pradesh successfully introduced electric mobility in subnational public transport for the first time in India. This was made possible by robust and innovative analyses employing a suite of tools, which identified and created an opportunity not considered feasible in the past.

State Governments require strong and reliable technical support for policy decisions. The policy climate needs to rightly address the challenges of adopting electric buses by providing an environment to accelerate their adoption and implementation. Like any new technology, a better understanding of EV technology and policy landscape is needed among the policy implementers, along with a robust assessment of the benefits.

Electric vehicles can be added to government vehicle fleets to increase awareness, expand product range, and demonstrate commitment. Also, with some of the largest public transport fleets, India's state transport programs can provide a significant market for the original equipment manufacturer (OEM) in the near future, to help build the market and technology environment.

Regulatory and fiscal incentives, such as tax benefits and subsidies, will play a critical role in creating a market for electric vehicles. The ancillary auto industry could be given tax breaks to work in tandem with the automobile manufacturers for providing necessary support in development of EVs. Government can also provide incentives to consumers such as tax exemptions to promote the adoption of EVs. The government can also consider establishing an exclusive, discounted electricity tariff for electric vehicles and linking renewable energy sources, such as hydroelectric power, for charging EVs.

Financial institutions have an important role in helping governments develop sound investment policies that promote electric vehicles. Public-private partnerships can also be enhanced

by encouraging access to finance for manufacturing and R&D.

Domestic production and in-house technology development will help the EV industry reach domestic self-sufficiency in manufacturing. In addition, creating new infrastructure for electric vehicles (such as charging infrastructure) increases density of the network and the possibilities for technological spillovers, such as for cars and two-wheelers.

Electric vehicles hold the potential of transforming global mobility. Countries with similar green growth challenges can work together to catalyze policy and financing solutions for electric mobility through knowledge sharing and capacity building.

Success Factors

- Green growth champions in the state government
- Technical and strategic competence of GGGI
- Persistent efforts of a small, multi-disciplinary team
- Innovative analyses
- Development of green growth diagnostic tools
- Extensive market stakeholder consultation and government engagement
- Mobilization of domestic finance through FAME
- Presence of enabling policy and regulatory landscape at state and national levels
- Technology advantages of EVs over ICE vehicles
- Usage of Innovative analytical tools to assess the viability gap
- Large Hydroelectric potential of the state and availability of surplus power

Impact

- First state in India to introduce electric vehicles in public transportation
- Policy and fiscal measures announced by the government to support electric vehicles
- Learning opportunity for other states
- Enhanced energy security: Investing in low carbon mobility technologies such as hybrid and electric vehicles would cut global spending on oil by USD 330 billion (£232 billion) each year between 2020 and 2030 – Cambridge Econometrics 2016
- Enhanced sustainable mobility
- Increased road safety
- Lower air pollution
- Lower GHG emissions
- Job creation
- Lower operational costs: lifetime operational cost of electric buses 65 percent lower than diesel buses

Limitations and Challenges

- Lack of technical capacity
- High upfront costs of EVs
- Price, range, and performance challenges with batteries;
- Need for greater consumer education and familiarization with EV technology to help accelerate adoption, as some surveys reveal low awareness about electric cars
- Low level of R&D and limited capabilities in developing technologies
- Limited domestic manufacturing capabilities and supply chains for EV buses, as well as bus components, particularly the batteries
- Lack of performance standards (range, speed, acceleration, etc.)
- Lack of policy and regulatory framework
- Lack of EV charging infrastructure
- Limited range of EVs
- Lack of markets EV bus for spare parts

Further Information

The findings of the case study are published in the following reports:

The Energy and Resources Institute and Global Green Growth Institute. Climate Resilient Green Growth

Strategies for Himachal Pradesh: Towards an Inclusive Development Agenda. New Delhi: The Energy and Resources Institute, 2015. http://www.teriin.org/projects/green/pdf/HP_Tech-report.pdf.

Global Green Growth Institute and Center for Study of Science, Technology and Policy. Electric Buses in India: Technology, Policy and Benefits. Seoul: Global Green Growth Institute, 2016. <http://gggi.org/wp-content/uploads/2016/10/Electric-Buses-in-India-Technology-Policy-and-Benefits.pdf>.

References

Bodhi, Anand. "To save environment Himachal to buy 25 electric buses - Times of India." The Times of India. May 16, 2016. Accessed August 7, 2016. <http://timesofindia.indiatimes.com/city/shimla/To-save-environment-Himachal-to-buy-25-electric-buses/articleshow/52287829.cms>.



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