Role of Government, private sector and civic society in promoting battery operated electric three-wheelers in Kathmandu, Nepal

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Introduction and background

Kathmandu Valley, which also includes the capital city of Nepal, is situated at 1,320-meter altitude from sea level and is surrounded by mountains. The topographic condition of the city is unfavourable to rising air pollution, which effectively blocks wind flows and thus enhance air pollution and photochemical smog. The air pollution in the Valley is increasing at alarming rate, the concentration of pollutants, especially particulate matters is well above health guidelines set by WHO. This has led into loss of atmospheric visibility and increase in asthma and respiration related heath problems in last one decade. The implication of air pollution is not only limited to health issues, it has also created a threat to tourism industry, which is one of the major economic activities in the valley. Motor vehicles are identified as the major source of air pollution in the Valley, mostly contributed by old and poorly maintained vehicles, low quality and adulterated fuel, prevalence of two wheelers and two stroke engine vehicles, increasing congestion, and inadequate and ill-serviced road infrastructure.

Box 1: Vital statistics of Kathmandu Valley

Area: 550 Sq. km (valley floor)
Altitude: 1350 metre from sea level
Road Length: 535 km (2002)
Registered vehicle population: 171,678
Vehicle composition: Car/jeep 23.7%, bus/truck 5.2%, 3 wheelers 2.9%, 2 wheelers 65. 3%, rest others (2001)
Pollutant concentration: 24-h average PM_{10} concentrations are 225,135 and 126 $\mu g/m^3$ in core, sub-core and remote parts of the valley, respectively, with the highest value of 495 $\mu g/m^3$. TSP concentrations are 376, 214 and 137 $\mu g/m^3$ in core, sub-core and remote parts of the city
Size of electric vehicle market: Rs. 500 million

Sources:
1. Department of Transport Management,
2. Ambient air quality monitoring of Kathmandu Valley. Final Report of ADB-TA-2847-NEP Project prepared by Nepal Environmental Services for Asian Development Bank, 1999, Kathmandu.
3. Electric Vehicle Association of Nepal

The diesel-operated Indian-made three wheelers, introduced in the valley in late 80's and early 90's, were visibly producing a cloud of black smoke and other air pollutants in the valley. Although, the new registration of such three wheelers had been banned since 1992, they were prohibited to use on street only from 1995. The combined effort of government, private sector and civil society (mainly NGOs and advocacy groups) produced synergy effect to promote and expand battery operated electric three wheelers on commercial basis in the valley to fulfil the vacuum created by expulsion of diesel three wheelers. This successful introduction of zero-emission (from tail pipe consideration) electric three-wheelers on commercial basis is noted as a successful practice in many international forum by USAID[1] and UN Sustainable Development[2]; the IPCC Special Report on Technology Transfer features it on its cover page. Although, end-of-the-pipe fixing of the pollutant emissions at the niche sector is not a solution to overall air quality problems, this experience provides a useful experience and a case of successful interaction of government, private sector and civil society in improving urban air quality by controlling vehicular emissions and promoting inherently clean vehicles. The experience is also of interests to other cities in the region, which harbours gasoline and diesel three-wheelers as one of the major stakeholders in public transportation system. Without some facilitation at the beginning, it would be impossible for these clean vehicles to take any market; the successfulness is viewed from that perspective in this paper. It has established a new industry,

[1] http://www.info.usaid.gov/countries/np/success/success2.htm
[2] Success Stories Vol 4/2000, http://www.un.org/esa/sustdev/success/PCBCP-5.htm

invited private sector investment, created employment opportunities, and promoted first experimentation of women drivers in Nepal's public transport sector.

In this paper, we have analysed why introduction of electric three-wheelers was successful in Kathmandu since electric vehicles have severe techno-economic limitations in other places. We also analysed the prevailing situation and the roles played by Government, private sector and advocacy groups. The role of various command-and-control and market based economic instruments were also illustrated. Lastly, the factors for their replicability are discussed and relevance of this experience to other cities in the region is explored.

The success story

Serious air pollution and smoke blenching three-wheelers

Figure 1. A typical battery operated three-wheeler in Kathmandu Valley (Courtesy: Clean Energy Nepan (CEN), Kathmandu, Nepal)

Gasoline operated three-wheelers were introduced in Kathmandu Valley as a cheap taxi since last few decades. Many cities in Indian sub-continent embraced those three-wheelers since foreign built cars were expensive and three wheelers served as cheap public taxies serving short distance commuting. These three-wheelers could carry three persons, including a driver, and powered by two-stroke engines. Kathmandu saw a sudden surge of diesel-operated three-wheelers during 1989-92, which was bigger than the former and could ferry ten passengers in its narrow chassis [3]. They ply-ed on the street emitting a thick black smoke and creating a lot of noise; at the time, there was no environmental standards for the emissions from motor vehicles in the Valley. Due to public out-cry over these polluting three-wheelers, government banned further registration of new three-wheelers in 1992. Despite growing public awareness over air quality and pressures from NGOs and other civic groups, a ban on these vehicles from plying on the street could not be carried out in early days due to a number of local specific economic and political difficulties. Policy makers failed to create any incentive mechanisms to abandon three-wheelers by its owners.

In a series of programs to improve environment, government set emission standards for in-use vehicles in 1994 (65 HSU for diesel vehicles and 3% CO by volume to gasoline vehicles [4]), formed Ministry of Environment in 1995, and passed Environmental Protection Act 2056 in 1997. Despite the announcement of phasing out of non-complying vehicle within two years in late 1998 (Budget Speech 2055/56) and despite the formulation of a phasing out program by Ministry of Environment, Department of Transport Management, and Local Municipalities government in consultation with private sector and NGO groups in early 1999, it could not be implemented. Anti-diesel three-wheeler movement peaked in early 1999 with the participation of NGOs, tourism sector, cine-artists associations, local clubs and the public. This even lead into the situation of street protests and road blockades for three wheelers. Finally, in 1999 budget (2056/57), Government provided an alternative to the owners of diesel three-wheelers for their replacement in the form of 75% custom holiday on import of 12-14 seater public transportation vehicles. Consequently, diesel three-wheelers were banned to ply in the Valley from July 1999.

Demonstration of techno-economic feasibility

[3] Built by Scooters India Ltd with payload of 1000 kg powered by 10 HP four stroke one cylinder diesel engine.
[4] This was later loosened. For two wheelers 4.5% CO was set in early 1998.

Interests on converting diesel to electric three-wheelers were generated as early as 1992 in the Valley. In 1993, on the request of Kathmandu Metropolitan Corporation, a US based NGO called Global Resources Institute with support from United States Agency for International Development (USAID) and US-Asia Environmental Partnership Program started a pilot project for designing and converting diesel three wheelers to electric three wheelers. By 1995, a total of 8 electric three-wheelers were designed and pilot-tested on one of the major routes in the valley for 6 months carrying over 200,000 passengers and travelling more than 175,000 km[5]. This was essentially a demonstration program for battery operated three-wheelers, which showed that such vehicles are economically feasible in the local context. This demonstration project, apart from designing vehicles also created awareness and acceptance of government, private sector and public.

Box 2: Key dates

- 1991 November: Ban on new registration of three wheelers
- 1993: Techno-economic feasibility demonstration of electric three wheelers by Global Resources Institute
- 1994 August: Announcement of in-use vehicle emission standard
- 1996 July: Reduced import custom tariff and sales tax on electric vehicle parts
- 1999 July: Ban on in-use diesel three-wheelers
- 2001 September: Number of electric three-wheelers over 600

Favourable government policy 1991-2000

From 1995 onwards, Government has provided several direct and indirect facilitation to EV industry as a consistent policy. The National Transport Policy-2001[6] further consolidates the policy of promoting electric transportation system in the country. The indirect facilitation consisted of mainly the ban on diesel three wheelers that created a market vacuum exploited by electric three-wheelers. Direct facilitation included fiscal benefit in the form of reduced import custom tariff and waiver on annual vehicle registration fee (annual registration fee is about 4,500 Rupees/year in 2001). 1996 Budget[7] reduced custom duty on parts and accessories of electric three-wheelers to 1% and completely waived sales tax[8]. Such policy has been continued in succeeding years thus greatly reducing the price of those vehicles and encouraging many private groups to invest into EV industry. From transportation management side, Government had provided a favourable route allocation to electric three-wheelers by wiping out competition from other three wheelers in early days, though it was later scrapped. These benefits to private sector helped to develop electric vehicle industry in the Valley. From fuel side, the state owned Nepal Electricity Authority provided electricity at low tariff rate for battery charging. Since majority of electricity in Nepal comes from run-off-river hydro power plants, charging of batteries could use the surplus and unutilised energy during off-peak period (night-time charging) with reduced tariff; electric vehicles was indeed a new market for the electric utility. So far, the price differences for normal and off-peak charging do not exist despite the fact that such prospects exist. EV sector also enjoys benefits that is offered to manufacturing industries that deal with energy efficiency, energy conservation and pollution abatement as announced by Industrial Enterprises Act 2049 (Article 15e). Under this, they are entitled up to 50% discount from taxable income for a period of seven years.

Table 1: Comparison of electric tariff rates, 2002 December

[5] Peter Moulton and Marilyn Cohen (1998), Promoting Electric Vehicles in the Developing World, Paper presented at International Electric Vehicles Conference, Coata Rica, November 1998.
[6] National Transport Policy 2058. Available from Ministry of Labour and Transport, Kathmandu, Nepal.
[7] Year 2053/54 budget presented to parliament.
[8] For diesel three-wheelers, import duty (and sales tax) was 60%; it was 160% for four wheelers. For batteries and electronic components it was 20-40%. The same Budget set 5% duty (and sales tax) on components of electric vehicles other than three-wheelers; 10% for all complete electric vehicles.

	Fixed power cost	Running energy cost
Electric three wheelers	Rs 200/kw (Rs 8000 for 40 kw)	Rs 4.30/kwh
Industry	Not available	Rs 5.10/kwh
Household	Not available	Rs 6.8/kwh

1 US$ is about 78 Rs in 2002.

For electric vehicle promotion, four government bodies has played important role. These include Ministry of Environment, Department of Transportation Management, Ministry of Finance and Valley Traffic Police. The role of Kathmandu Metropolitan Corporation was limited to push the government and bringing stakeholders together since it did not have jurisdiction over this area.

Emergence of a new industry

The demonstration project showed that battery operated three wheelers are techno-economically feasible in the Valley. Private sector caught attention of investing in this industry. Since then, role of private sector has been main impetus for expansion of electric vehicles. Seven converted electric three-wheelers in demonstration project was bought by a private company and expanded the fleet size further to 15, these vehicles were operated in more routes in the Valley. Investment of about 500 million Rupees[9] has already been made in EV industry in the valley[10]. By year 2002, over 600 electric three-wheeler were manufactured, sold and operated by private sector in the valley. They ply on 16 routes in the valley today and also employ over 70 women drivers.

Box 3: Performance of batteries

Type: Trojan, US125 and Excite USA
Cost: Rs 60,000 per pack (12 batteries each of 6 volts)
Average driving distance per charge: 65 km
Energy per charge: 15-18 Kwh
Average cycle life: 450
Average life: 18 months (improvement from earlier 9-10 months)

The EV industry in the Valley principally consists of three major groups; vehicle manufacturers, vehicle owners and charging station operators. Currently, there are about 5 major manufacturers[11], 38 battery charging centres, and many owners[12]. Each charging centre owns about 5-10 vehicles, and individuals own rests.

Some success has also been made in adaptation to local technology as an alternative to expensive imported technology, especially in chargers; this has enabled to reduce cost to some extent. Energy source for EVs, i.e. battery, is one of the major factors in EV. The cost and performance of batteries are often barrier to a full-scale diffusion of electric vehicle in any transportation system. In the Valley, electric three-wheelers today are commuting in short and fixed routes of 120 km in daily basis changing battery once a day. The average route length of about 10-13 km serves well for the capacity of electric three wheelers. Three types of batteries are used in the electric three wheelers in the Valley; Trojan, US125 and Excite USA. Since the cost of the battery is of a serious concern, a mechanism of battery leasing is devised by the EV industry, as a result, 99% of the battery are acquired from the lease system today. In this mechanism 50% down payment is made in the beginning and remaining payments can be made in an instalment basis over several months with 7% interest rates. This had started an additional expansion of industry.

Electric Vehicle Association of Nepal makes an umbrella organisation of EV industry. This association integrates charging station operators' association, manufacturers' association and owners' association and lobby for EV industry with the government, media and public at large.

Efforts of NGOs and of civic society

[9] On average, an electric three-wheeler costs Rs. 540,000. A charging station investment is about Rs. 1.5 Mn
[10] Personal communication made at Electric Vehicle Association of Nepal.
[11] The major EV manufacturers are Nepal Electric Vehicle Industry (NEVI) and Electric Vehicle Company (EVCO) that has share of about 40% each in local EV market.
[12] About 450 owners

The role of advocacy and civil groups was outstanding in opposing diesel three-wheelers and facilitating the introduction of electric three-wheelers in the Valley. These civic groups organised a number of activities that created public awareness on air pollution, role of polluting vehicles and need for clean vehicles. They also created a forum to stimulate discussions among private sector, public and the Government for technical and policy debates and lobbied for electric vehicles. The major NGOs and civic groups involved in these issues were Martin Chautari, Winrock International-Nepal Office, Leaders Nepal, Abhiyan Group (cite-artists' group), Pro-public and The Explore Nepal (tourism sector's group). A number of other organisations, groups and local clubs also took part in the protests against diesel three wheelers. At the peak of protests, groups such as Abhiyan and local clubs boycotted and physically blocked the operation of diesel three-wheelers on street, demonstration and mass rallies were organised, FM talk programs were held, and lawsuits were filed in court against the diesel three-wheelers. Role of media was favourable to these issues which disseminated the air pollution concerns from diesel three wheelers and motor vehicles to public with priority. All these activities put tremendous pressure on Government to act.

Replicability and significance to other cities

Local condition

Before discussing replicability and significance of Kathmandu's experience to other cities, it is important to discuss the local conditions under which these electric three-wheelers were successful. The phasing out of diesel three-wheelers and introduction of electric three-wheelers were made amid a chaotic air pollution where public support could easily gathered for such an action. Geographic situation, traffic pattern, travel demand, and energy availability affect choice and feasibility of electric vehicles in urban transportation system. These barriers mainly emerge from the limitation of battery technology. However, Kathmandu Valley is about 550 Square kilometres and majority of the vehicle ply inside a circle with 15-20 kilometres diameter. The top speed of the traffic in the city does not go beyond 30-35 km/hour while average speed is as low as 10-12 km/hour. In such condition, top speed and driving distance did not become serious constraint for electric three-wheelers. Further, when these vehicles run on the fixed routes, battery changing could easily carried out once or twice a day. Nepal also has a great potential for hydroelectric power. Most of these hydro-plants are run-of-the-river type where electricity would be "spilled away" if not unutilised during surplus or off-peak time. Therefore, a low tariff rate for off-peak charging of batteries was possible; in that case the country could save huge amount of foreign currency (for trade deficit country like Nepal) and financial resources spent on foreign oil if a significant number of electric vehicles ply on the street. Although, such off-peak charging mechanism and time-of-day tariff was not created in 1995-2000, such psycho helped to create a favourable response from public and policy makers at a great extent. Foreign donor's interest is also one of the important local factor in case of electric three-wheelers in the Valley. The role of two donor communities, USAID (US ODA agency) and DANIDA (Danish ODA agency) was very instrumental; USAID/US-AEP supported the demonstration programs and DANIDA supported at later stages. Since donors are influential in many of the governmental policies, such donor interest helped to create a favourable response from the policy makers.

Significance to other cities

Three-wheelers make a significant part of urban transportation system in cities of South Asia[13], mainly in India, Pakistan, Sri Lanka and Bangladesh. In some other cities such as Bangkok, tuk-tuks are very popular for a short distance commuting. Three-wheelers are also popular in Chinese cities. However, governments in South Asia are struggling to phase out three wheelers, which runs mostly by two-stroke gasoline engines and significantly responsible for worsening air pollution. In many cases, cheaper mode of transportation such as three-wheelers are closely linked to low-income groups of the society and inter-twined with urban poverty issues. This makes even harder to ban or replace

[13] South Asia refers to Nepal, India, Sri Lanka, Pakistan, Bhutan, Maldives, Bangladesh (Indian sub-continent)

those vehicles without providing some form of alternatives to its owners. In most cases, those vehicles are being pushed out from cities rather than phasing out. Bangladesh announced a ban on three-wheelers with two-stroke engines in Dhaka City from September 1, 2002 affecting nearly 12,500 such vehicles[14]. Government in Bangladesh has permitted 5,000 four-stroke CNG three-wheelers to ply on the street to void the gaps in travel demand due to such ban[15]. Possibilities for replacing Kathmandu's experience in Dhaka is being examined by Bangladesh Centre for Advanced Studies (BCAS)'s SouthSouthNorth Project[16].

Table 2: Three-wheelers in South Asia [17]

Country	Two-stroke	Four stroke
Nepal 1999	-	5,900 (including two stroke)
Bangladesh 1999	68,000	7,600
India 1997	1,180,000	210,000
Pakistan 1999	91,000	-
Sri Lanka 1997	59,000	-

- refers *data not available*

Learning from the success from its demonstration program of converting diesel three-wheelers to electric in Kathmandu, USAID is providing assistance in India in a program called "India Zero Emissions Transportation Program (IZET)" for 1999-2003. The objective of this program is to reduce health impacts from vehicular emissions and is essentially a demonstration program in Delhi, Agra and Pune where 1,000 electric-three wheelers will be designed, tested, assembled. Under this program seven three-wheelers were field tested in the city of Agra for one year. With this success, two private sectors (Bajaj Auto Limited of India and New Generation Motors of USA) are entering into a joint venture to produce 1,000 electric three-wheelers in India. USAID will provide 3.9 million US$ in 9.3 million US$ program, rest is borne by private sectors[18].

Kathmandu's experience is a good case for exploring the role of electric three-wheelers in cities where a significant number of gasoline or diesel three-wheelers exist and where three-wheelers are responsible for significant air pollution. However, introducing electric vehicles should not only limited to designing and testing vehicles; this should be supplemented by creating public awareness and acceptances, creating laws and regulations, government policies and incentive mechanisms for removing initial market barriers, and inviting private investment in a commercial basis. A synergy of the roles played by government, private sector and advocacy groups can make successful introduction of such vehicles. It should be mentioned that three-wheelers are low occupancy public transport modes and a large-scale penetration of these vehicles may lead to a slow down of other forms of transport system through congestion and other externalities. They are best suited for a short commuting and their fuller integration with other high occupancy public vehicles through a well-designed transportation planning is essential.

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[14] Bangladesh Centre for Advanced Studies web-page http://www.bcas.net/ accessed on December 25, 2002.
[15] Bangladesh has large natural gas reserves and an extensive network of gas pipelines in Dhaka.
[16] Recent BCAS News http://www.bcas.net/ assessed on 3 January 2003 at
[17] Masami Kojima, Carter Brandon, Jitendra Shah, Improving Urban Air Quality in South Asia by Reducing Emissions from Two-Stroke Engine Vehicles, The World Bank, December 2000, Washington DC.
[18] For complete project see web-page of US Department of Energy, Office of Policy and International Affairs, http://www.pi.energy.gov/library/EWSLindia-izet.pdf