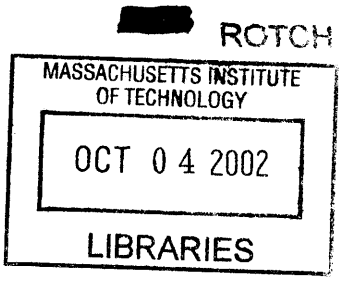
Electric Vehicle Technology in Kathmandu, Nepal: A Closer Look at its Development



by

Sushila Maharjan

Bachelor of Engineering in Environmental Engineering
Royal Melbourne Institute of Technology (RMIT) University, 1997

Submitted to the Department of Urban Studies and Planning in Partial Fulfillment of the Requirements for the Degree of

MASTER IN CITY PLANNING
at the
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

September 2002

Signature of Author: _____
Department of Urban Studies and Planning
July 10, 2002

Certified by: _____
Professor Lawrence Susskind
Department of Urban Studies and Planning
Thesis Supervisor

Accepted by: _____
Professor Dennis Frenchman
Department of Urban Studies and Planning
Chair, Master of City Planning Committee

Electric Vehicle Technology in Kathmandu, Nepal: A Closer Look at its Development

by

Sushila Maharjan

Submitted to the Department of Urban Studies and Planning on July 10, 2002 in partial fulfillment of the requirements for the degree of Master in City Planning

ABSTRACT

Electric vehicle (EV) development in the Kathmandu Valley began in 1993 as a response to the urgency of a severe air pollution situation. The dynamics of government intervention, non-governmental organization advocacy, international donor support, and private sector involvement all shaped EV implementation in various ways. Its success led other South and East Asian cities to view it as a model for implementing EVs to alleviate air pollution. Yet despite a promising beginning and intensive proliferation, the EV industry was failing only six years after its inception. What went wrong with a development that seemed to have all the makings of success?

This thesis outlines the EV development trajectory and examines the principal factors that impeded progress. Interviews with over 30 individuals in the electric vehicle industry, government agencies, NGOs, and international donor organizations provided me with first-hand accounts of the puzzles of EV development. Also, my research in published and unpublished documents, local press coverage, and an EV news server added rich material for analysis. The most entrenched barriers to the implementation of the EV industry have been the disparate interests and goals of stakeholders, in particular the resistance and hostility of fossil-fuel interests, and deficiencies in human resources and support networks. Analysis of these impediments yields lessons on how EV advocates can overcome these obstacles. Lessons learned in this thesis are that EV advocates must build a coalition of supportive actors, seek governmental commitment for EV-supportive polices, work to align the disparate economic goals of private actors, and develop a capacity for training and education.

Thesis Supervisor: Lawrence Susskind
Title: Ford Professor of Urban and Environmental Planning

ACKNOWLEDGEMENTS

I want to thank my thesis advisor, Professor Lawrence Susskind, for his patience and insightful guidance. Without his help, I would still be wandering. I also want to thank my readers, Professor William Moomaw and Professor Ralph Gakenheimer, for their invaluable input and suggestions. I am also appreciative of Dr. David Laws, who taught me useful lessons about narrative. Thank you all for helping me to focus my thoughts on a very few important points, at the same time keeping a broader perspective.

My thanks go to Catherine Diaz, my classmate at DUSP, for bearing with me in my turbulent ordeal of thesis writing. I should not omit thanking Chikaka Sassa, either, for her moral support. I truly appreciate their friendship and kindness. I also thank my friends, Shailesh Gongal and Arnico Panday, for their comments on and ideas for my thesis drafts. They helped me through the painful stages of thesis writing.

In Kathmandu, I am indebted to Mr. Bikash Pandey and Mr. Bimal Aryal for their support throughout my field research. They represent a walking library and their insight into the EV development process has been most valuable.

I am also thankful to the staff of the MIT Writing Center, especially Bob Irwin, who helped me find appropriate wording for my thoughts and also offered me useful ideas.

Lastly, I am grateful to my father and mother for their lifelong dedication. Their prayers have become my strength. I am also thankful to my four siblings, especially my sister Bidhya, who is unfailingly generous and helped me keep my sanity with her enlightened talks.

Sushila Maharjan

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOS

Introduction

Why Focus on Electric Vehicle Development?

Cities in the world are increasingly grappling with air pollution. Transportation is responsible for almost half of all air pollution in many cities.[1] For some cities, the estimates are even higher. For example, in Mexico City, motor vehicles account for 99% of total Carbon monoxide emissions, 54% of hydrocarbons, and 70% of nitrogen oxides.[2] The emissions of criteria pollutants such as carbon monoxide (CO), carbon dioxide (CO_2), hydrocarbons (HC), sulphur oxides (SO_x), nitrogen oxides (NO_x), particulate matter (PM), and lead from fossil-fuel-powered vehicles are found to be detrimental to human health, leading to high economic and social costs.[3] On the regional level, the emissions of SO_x and NO_x are known to cause acid rainfall, resulting in water and land contamination in areas beyond the pollution source. Epidemiological studies estimate that developing countries suffer tens of thousands of excess deaths and lose billions of dollars in medical costs and productivity because of urban air pollution.[4]

One of the cleaner alternative technologies for sustainable transportation is battery-powered electric vehicle (EV)[5] technology. EV technology uses electricity as a fuel, as opposed to hydrocarbon-based fossil fuel, thereby reducing the exploitation of the earth's non-renewable fossil energy. Electric vehicles produce almost zero emissions in cities if the electricity generating power plants are not located within cities.[6] In the case of hydropower electricity, direct and indirect emissions are practically zero.[7] Given the potential of electric vehicles to alleviate vehicular air pollution, many cities have attempted to introduce EV for commercial transportation. For example, California's zero-emissions mandate of 1990 required a minimum two percent of vehicle sales in California (about 20,000) to be zero emission vehicles from 1998, increasing at the rate

---

[1] Sperling, D. 1995. pp-44.
[2] Gautam, S.P. and Onursal, B. 1997. Chapter 1, pp-2.
[3] Gautam, S.P. and Onursal, B. 1997.
[4] Faiz, A., Weaver, C. S., and Walsh, M. P. 1996. Page-xiii.
[5] For the purpose of simplicity, the abbreviation EV for electric vehicle is used throughout this thesis. In the later part of my thesis, I have used EV interchangeably with the Safa tempo.
[6] Sperling, Daniel 1995. pp-44; OECD/IEA. 1992.
[7] Sperling, Daniel 1995. pp-44; OECD/IEA. 1992

of 5% in 2001 and 10% in 2003.[8] Another example is La Rochelle in France where a fleet of electric vehicles was tested from 1993 and 1995.[9] Similarly, many other cities in Europe and other regions have undertaken EV initiatives. But, none of them were able to achieve wide-scale implementation of electric vehicles as was hoped. [10] Like any new technology, electric vehicles also face a number of implementation barriers. Management, performance, infrastructure, human resources, and policy are some of the barriers. In this context, a study on EV development might shed new light on the dynamics of EV adoption and the barriers it faces in its implementation.

Why Choose Kathmandu City for a Case Study?

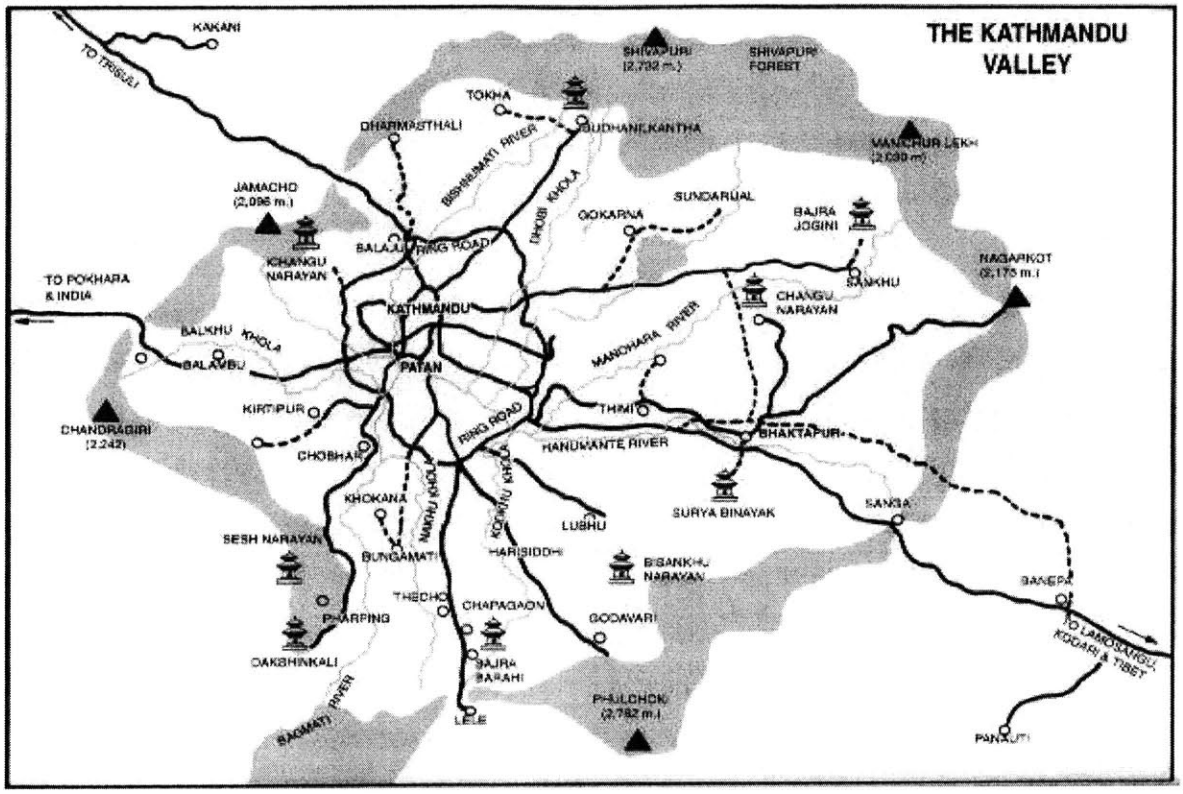


Photo 1: Map of Kathmandu

[8] Laws et al. 2001.
[9] Laws et al. 2001.
[10] Kemp et al. 1998.

Kathmandu City has suffered from severe air pollution for more than a decade. And yet the city has also been acclaimed for its large number of three-wheeled electric vehicles. [11] These three-wheeled vehicles are locally known as the "Safa tempo" ("Safa" means "Clean" and "tempo" is a generic name for a three-wheeler). What began as a demonstration program with a fleet of just 7 vehicles developed into a full-fledged industry with almost 600 Safa tempos, 36 charging stations, 4 charger manufacturers, 4 repair and maintenance workshops, and 5 or 6 dealers for battery and spare parts. These tempos serve about 100,000 people every day.[12] The city has the distinction of being the first city in South Asia to run zero emissions vehicles.[13] Some sources even claim that there is no city in the world where there are as many EVs per capita as in Nepal.[14] Many Nepali as well as international air quality advocates consider it the means of clean transportation best suited for Kathmandu. The EV industry was the one of the very first transportation industries to rally support from international and national non-governmental organizations (I/NGOs), international donors organizations, and the private sector. To a foreign visitor, it is a "miracle" to see the Safa tempos picking up and dropping off passengers all day, seven days a week, in many parts of the city.[15] From the outside, the industry gives the impression that it is a "success story" and that it is surviving despite corruption and resistance from a fossil-fuel transportation group called the "diesel mafia."[16] In fact, the industry has been struggling and is at the moment in deep crisis.

With the support from the government and the public, Global Resources Institute (GRI), a U.S.-based international non-governmental organization (INGO) demonstrated and proved the technological and commercial viability of seven Safa tempos. The private sector picked up on it and developed into a full-fledged industry by manufacturing vehicles, building and operating their support infrastructures. While many new

---

[11] Lonely Planet. 2000.
[12] Eisenring, M. 2000.
[13] The Rising Nepal. February 24, 1996.
[14] Cited in Baral et al. 2001.
[15] Remarks of Adam Friedensohn, Chairman, Lotus Energy. Adam Friedensohn is a founder member of EVCO and is currently Chairman of the Lotus Energy and also a Chief Advisor to Himalaya Light Foundation.
[16] Interview Adam Friedensohn.

technology experiments do not go beyond the experimentation phase,[17] EV technology not only successfully passed its testing but was also able to penetrate the transportation market against all odds. A number of factors seem to have contributed to its growth; government intervention, NGO advocacy and lobbying; international donor assistance; and involvement of the private sector.

As recently as 2000, several major cities in South Asia were reported to have asked for guidance concerning promotion of electric vehicles to reduce air pollution.[18] However, things do not look as rosy today as they once appeared. Vehicle production has completely stopped; the government has banned the entry of new three-wheelers vehicles, including the Safa, into Kathmandu City. The market value for a second vehicle has sunk below US$2,008 (NPR[19] 150,000) compared to the first-hand price of US$5,220 (NPR 39,0000).[20] Entrepreneurs no longer want to get involved in this enterprise.[21]

What happened to the growth of this technology that seems to have all the ingredients for success? Learning what went wrong is crucial. My thesis examines the development pattern of electric vehicle technology in Kathmnadu City. It seeks to uncover key policies, and players that have influenced the evolution process. Looking at dynamics of various policies and the efforts of the private sector, NGOs, and international donors, I then examine the impediments that came into play in the EV development. Opposition from fossil-fuel interest groups, failed management, and the lack of support networks played a large role in creating impediments and analysis of these impediments reveals some of the policy and player dynamics of EV technology development. Through this analysis, I will provide insights into some of the major lessons we can learn from this development experiment. In short, through this case study, we can thereby better understand the development pattern of EV in the context of a developing country and spur thinking about how it can be done more successfully in the future.

---

[17] Weber, Matthias and Dorda, Andreas, D. February 1999.
[18] Faiz, A., Weaver, C.S., and Walsh, M. A. 1996.
[19] NPR = Nepalese Rupees
[20] Interview with operator-entrepreneurs and manufacturers.
[21] Interview with Bimal Aryal, Hridaya Manandhar, and Ashok Pandey. Bimal Arayal has been involved as a Researcher with Martin Chautari's Promotion of Electric Vehicles Project since the project's inception.

Thesis Structure

This thesis is structured in three parts:

Part I: History of Electric Vehicle (EV) Development in Kathmandu

This part gives an overview of the developmental pattern of EV technology from year 1993 to 2000. It starts with the inception phase, followed by major proliferation, leading to the phase when the EV growth started to decline. Then, it investigates the dynamics of evolution by looking into how and what major policy efforts came about. Also, it looks at the different efforts of players that influenced the process.

Part II: Analysis of Barriers

In this part, the above observations are used to identify and examine the barriers that impeded the EV expansion. Opposition from anti-EV groups, and management failure, and the lack of effective networks among stakeholders presented major barriers leading to the end of the EV growth by the end of 2000. These barriers are analyzed in terms of the economic interests of various players and their approaches.

Part III – Lessons Learned

Through understanding of the policy and players' dynamics discussed in Part II, this part provides insights into the lessons that EV advocates can learn from this development experience. Sound policy measures, building coalitions to overcome opposition, organizing the interests of the private sector, and building human resource are some of the sustainability strategies on which successful EV development depends.

Conclusions

The conclusion summarizes the lessons learned. For cities of other countries with similar socio-technological and economic contexts, it outlines key factors that EV advocates should consider when embarking on the implementation of EV technology.

Scope of the Research

My thesis focuses on the development context of battery-powered electric vehicle technology within Kathmandu. The scope of the research is limited in four ways:

1. It is limited to three-wheeled EVs, the "Safa tempos" that occurred from 1993 to 2000. By the end of 2000, the EV industry started failing. Since I aimed to study the principal factors that led to the decline in the EV growth, I only considered the duration 1993-2000. In Kathmandu, trolley buses, another type of electric vehicle, also exist. But the technology was introduced in a different context in 1977. Therefore, the issues concerning trolley buses fall outside the scope of my thesis.
2. Geographically, my analysis covers only the developments in Kathmandu. First, the EV development is focused on only Kathmandu City and part of nearby Patan City. Second, some expansions of the Safa tempos have occurred in other cities of Nepal only from the end of 2000. Thus, these factors make the geographical boundary of Kathmandu a logical choice for studying the development covering the time period between 1993 and 2000.
3. Regarding EV competitors, the thesis will discuss only those with which EVs directly compete: Liquid Petroleum Gas (LPG) vehicles and microbuses.
4. Since my thesis approaches EV development more from the perspective of cleaner technology implementation than that of transportation planning, the thesis will not discuss in detail the transportation issues connected to EVs.

Methodology

My research is based on information from two kinds of sources:

Literature reviews: The primary source of information is published and unpublished documents from non-governmental organizations (NGOs) and government. Extensive review of local press coverage, an Alternative Fuel Vehicle News server, and government notifications also provided rich materials in putting together the puzzles of EV development trajectory. In addition, I also referred to other literatures related to the

management and assessment of a new technology, the theories of economics, and the roles of environmental NGOs for in-depth analysis.

Structured interviews and data collection: From January 20 to February 10, 2002, I visited Kathmandu to conduct structured interviews with EV stakeholders. I interviewed government officials; EV entrepreneurs including manufacturers, operators and charging station owners; Non Governmental Organizations (National and International) including Martin Chautari, Clean Energy Nepal, and Winrock International Nepal; and international donors such as Danish International Aid Agency and Swiss Development Agency. In the U.S., I consulted with the Global Resources Institute, a U.S.-based international non-governmental organization, which pioneered the introduction of EV technology in Nepal. The list of 33 individuals interviewed and the questions asked are included in Annex 1 & 2. Attending an EV promotion workshop in February 5, 2002, also provided useful insight into the making of the industry and information about the stakeholder dynamics. In addition, I also based my analysis on secondary data that I collected in Nepal.

Part I: History of Electric Vehicle Technology Development in Kathmandu

This section first gives an overview of the events surrounding the adoption of EV technology in the Katmandu Valley. It begins with an inception phase, followed by proliferation, leading to the present decline of EV growth. It then investigates the impacts of major policy developments on implementation. Also, this section looks at the contributions that different players made during the process. The efforts of government, the private sector, non-governmental organizations, local municipal bodies, and international donors all had an impact on the pattern of technology adoption and diffusion.

Introduction to Electric Vehicle Technology

Electric vehicles are zero emissions vehicles that are powered by an electric motor drawing a current from rechargeable batteries. Electric Vehicle (EV) technology is generally expensive, with the battery comprising the greatest share of the cost.[22] The EV technology that was introduced to Kathmandu City came "off-the-shelf." Experts applied this technology to produce an electric three-wheeler. This vehicle is unique to Kathmandu City and is locally named "the Safa tempo."

There were a number of reasons for choosing three-wheeler public transportation.[23] This sector required only modest performance standards that could be met by a very simple and affordable electric vehicle technology design. These public transportation vehicles operate on fixed routes which means that they provide better conditions for battery charging and exchange. These three-wheelers, especially the Vikram tempos, were known as the worst polluters in the city. Thus, displacing those with clean ones would ensure easy acceptance and attention from the public and government all alike. Three-

[22] Sperling, Daniel. 1995. Pp-55.
[23] Moulton, P. and Cohen, M. 1998; Peter Moulton and Marilyn Cohen from the Global Resources Institute undertook the first Electric Vehicle Demonstration Project in Nepal.

wheelers are considered the most affordable low-cost means of public transportation in Nepal and in all of South Asia.

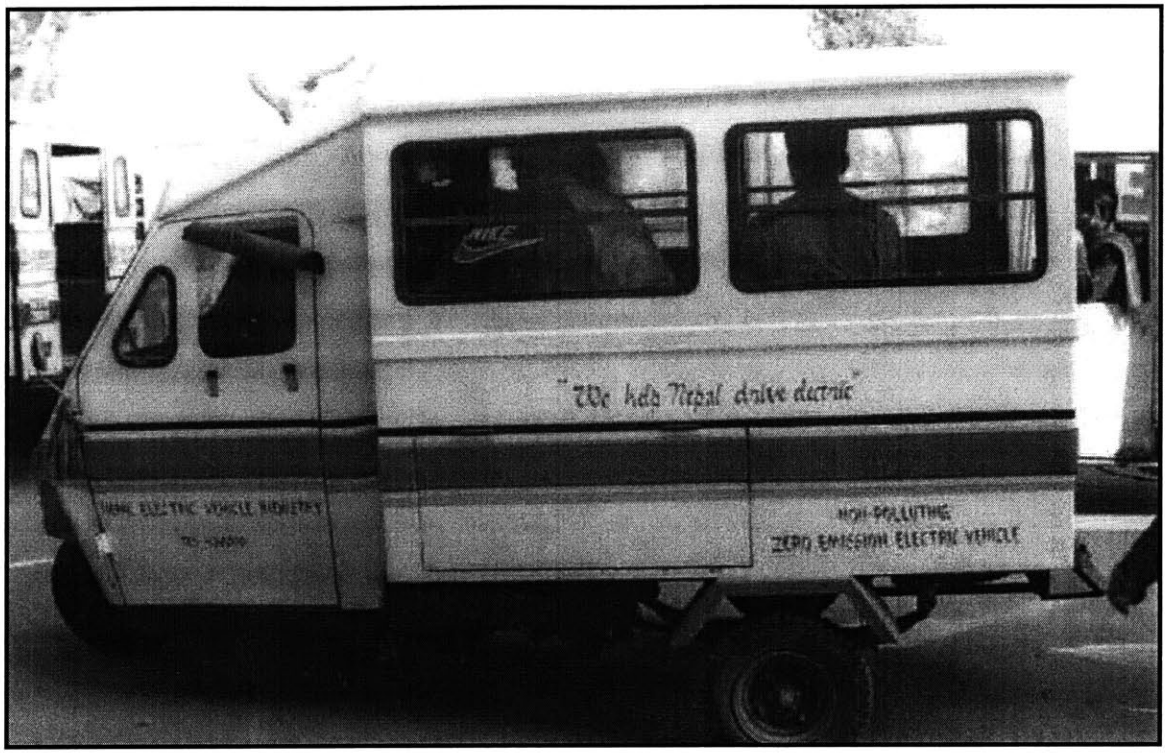


Photo 2: The Safa Tempo

The Safa tempo involves a composite of several components: a chassis with a steering wheel (a skeleton of the Safa tempo); an advanced D.C. motor (K91-4003 6.7" motor) or Prestollite motor; a motor controller (Curtis 1209B); 72 volts of battery power (12-Trojan 125 batteries); a body; and other miscellaneous parts such as a reverse-forward switch, motor mounting plates, couplings, a carbon brush, and a fuel gauge.[24] Most were readily available from other countries. There are fewer parts in an electric vehicle than in other fossil-fueled vehicles and the parts are designed to last many years if handled properly.[25] While the components are specific to electric vehicle production, the chassis is a popular size, originally built for Vikram tempo, not the Safa tempo. It can carry up to 11 passengers including the driver. The battery technology used is deep-cycle lead acid batteries. Deep recycle batteries are designed for deep discharge cycles and use thick

[24] Moulton, P. and Cohen, M. 1998.
[25] Baral, A., Parajuli R., and Aryal B. 2000.

lead plates dipped in an acid electrolyte. They usually have a life span of about 700 to 800 cycles (each cycle of a battery covers a state from full charge to 80% discharge)[26]. The design is optimal since the vehicle is operated close to design limits. Since the technology is simple, it is both affordable and acceptable.

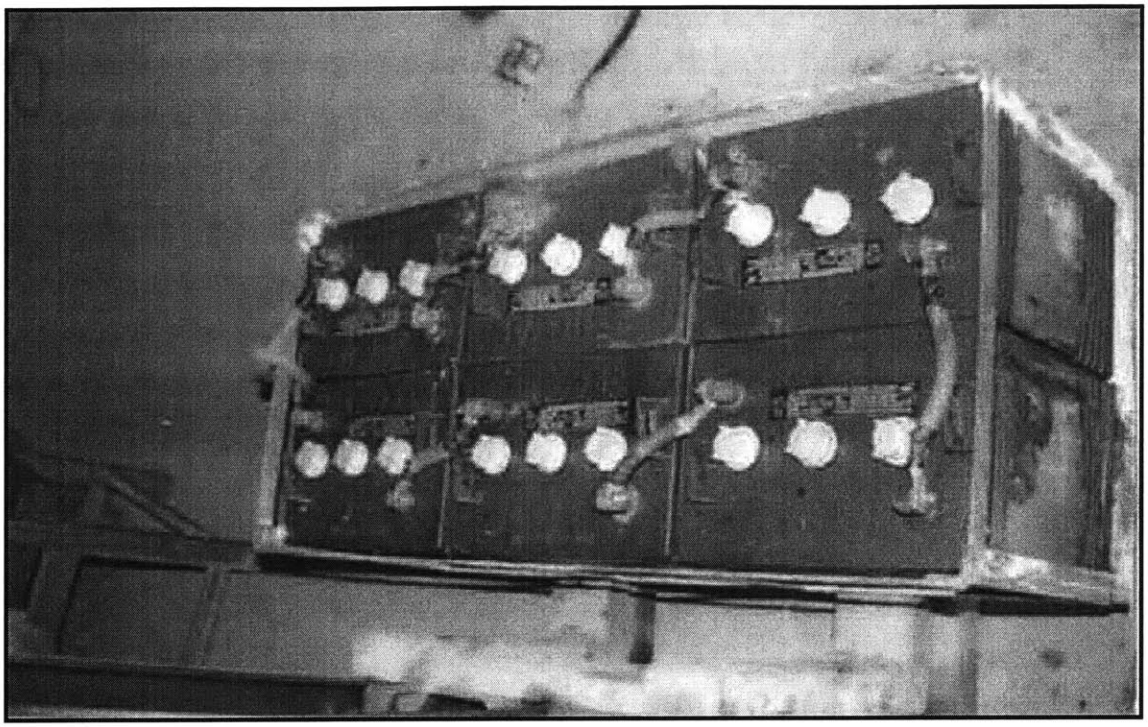


Photo 3: A Set of Six Deep-Cycle Lead Acid Batteries

The most sensitive part of the Safa tempo is its batteries. They are expensive, have limitations in range (distance covered by one set of fully charged batteries), speed and are problematic because of their weight and high maintenance. Since the batteries alone weigh 360 kg, they take up nearly half the vehicle's load. Because of heavy batteries, the vehicle can accommodate an extra load of only 550 kg for 10 passengers plus driver. Maximum speed is 45 km/hr and the maximum range on one charge of the batteries is 60 km. For each Safa tempo, two sets of batteries are used for daily operation. The batteries are placed in metal "baskets," six to a basket on each side of the Tempo directly underneath the seats, each basket weighing about 180 kg. Each battery is cycled daily and the battery life span is approximately 750 cycles, which is about 22-24 months for the nature of this particular Safa tempo operation.

---

[26] Deep Cycle Batteries: <http://www.windsun.com/Batteries/battery_Glos.htm>

Charging and maintaining EV batteries requires considerable care. While the lead acid batteries can receive 80% of their full charge very quickly, the final 20% is much more difficult. Vehicle overloading and overdriving can cause battery deterioration. In addition, Safa tempos cannot cover more than 55 km when their batteries age. Also, at high speed, the range is reduced considerably.[27]

For daily operation, the Safa tempo makes a certain number of roundtrips on fixed routes, carrying 10 to 12 passengers at a time within the ring road of Kathmandu where the travel speed is modest. Because of the nature of EV batteries as fuel, it can make only a certain number of loops. More specifically, each Safa tempo can make 5 to 10 loops a day, depending on the length of the routes. Batteries are charged and exchanged twice a day at a charging station.

Table 1: Cost and Operation Features

Cost of a Safa tempo without battery sets	US$ 5,065
Cost of battery sets of two	US$ 1,720
Payback period for each vehicle	22 months
Average distance traveled per day	120 km
Average battery exchange per day	2

Source: Eisenring, M. (2000); Aryal et al. (1999).

[27] Eisenring, M. July 2000.

Chronology of Development

Electric vehicle technology was introduced in Kathmandu because of the urgency of the air pollution situation. In order to understand the dynamics of the development in Kathmandu's transportation market, I have focused on the emergence of government policies and on the interplay among the government, the private sector, donors, and non-governmental organizations.

EV technology development occurred in four distinct phases, including the current continuing phase.

Table 2: General Chronology of the Electric Vehicle Development in Kathmandu
Phase I : Conception and Demonstration (1993-1996) - Idea conceptualization for EV technology - Formation of Global Resources Institute - A 6-month testing period to prove commercial and technical viability - Intensive networking with government, for creating a favorable policy environment, and with the private sector for commercial take over
Phase II: Incremental Growth (1997- 1999) - Evolution of private sector – Nepal Electric Vehicle Industry and Electric Vehicle Company. - Soft lobbying and advocacy by Non Governmental Organizations (NGOs) - Electric Vehicle Promotion Project by Martin Chautari - Emergence of Danish International Development Agency's Interest (DANIDA)
Phase III: Intensive Proliferations (1999-2000) - Banning of Vikram tempos followed by heightened EV Proliferation - Amplification of oppositions from vested interest groups - Intensification of advocacy and lobbying of NGOs - Appearance of donors' lobbying - Entry of microbuses - Organizations of EV stakeholders through associations (Nepal Electric Vehicle Manufacturing, Clean Locomotive Entrepreneurs Association of Nepal, Nepal Electric Vehicle Charging association) - Ban on the new registration of all three-wheelers
Phase IV: Learning and Reflection (2001-Spring 2002) - Realizations by EV stakeholders - New proposals for the management of the EV industry - Protective measures from the government - Involvement of DANIDA in human resource development and institutional strengthening of EV associations. - Expansion of NGO roles

Phase I: Conception and Demonstration Phase (1993-1996)

The idea of using commercial electric vehicles in Kathmandu City for cleaner transportation was first conceived during a visit of the delegation of the Kathmandu Municipality to the city of Eugene, Oregon, in 1993. Kathmandu and Eugene have a sister-city relationship that was begun in 1975. This relationship was inspired by the beauty of the Kathmandu Valley, popularly known as " a Shangri-La" to many visitors back then. By 1990, however, this Shangri-la image had already started to fade. The number of vehicles in the area had increased by approximately 90% to 67,000 over the span of more than 10 years, causing increasing air pollution in the Valley. The annual record of the number of days with good visibility (measured at greater than 8,000 meters at 11.45 local time) dropped from 115 days in early 1970s to only 20 days in 1992/1993.[28]

In addition, a large number of brick kilns, a big cement factory and the bowl-shaped topography of the Valley (which creates poor dispersion conditions) all contributed to the increased pollution level in the Valley. A 1995 study indicated that the total emissions in the Kathmandu Valley were 63,000 tons per year, consisting of about 56,000 tons of carbon monoxide, 5000 tons of nitrogen oxides, 1000 tons of hydrocarbons, and 840 tons of sulphur dioxide.[29] Among various polluters, diesel-operated three-wheelers known as "Vikram tempos", stood out because of their very visible emissions. Commonly known as "smoke-belching tempos," their tail-pipe emission testing also demonstrated that they were three times as polluting as petrol-operated vehicles. The emissions factor of total suspended particulate (TSP) for diesel- and petrol-operated tempos were found to be 0.50 grams and 1.5 grams per kilometer run of a vehicle.[30] Hence, despite their being only 1% (640 in number) of the total fleet of vehicles in Kathmandu Valley, a study estimated that their contribution to the Valley's pollution was approximately 10% (of all air pollution).[31] To many people, the Vikram was seen as the main problem. Its black smoke became so unpopular among the residents of the Valley

---

[28] Giri et al. October 1996.
[29] Cited in Baral et al. 2001.
[30] Giri et al. 1996. Appendix 5.
[31] Baral, A., Parajuli R., and Aryal B. 2000. Pp-7.

that some residents even threatened to stone Vikram tempos if the vehicles ran in their locality.[32] In response to this problem, the Government stopped the registration of new smoke-belching Vikram tempos in the Bagmati District in 1992 (which includes the Kathmandu Valley) with the aim of reducing the number of polluting vehicles. This created the opportunity for alternative clean electric and gas vehicles.

Idea Materialization

> *"If this is possible, don't just study the problem.*
> *Please form a group to do something about it."*[33]

It was this very statement by Mr. Narendra Raj Joshi, the Deputy Mayor of Kathmandu City that set off the process of developing an electric vehicle industry in Kathmandu City. Mr. Peter Moulton, the chairman of "Kathmandu-Eugene City committee," proposed converting all polluting tempos to electric power go alleviate the deteriorating air quality of the Kathmandu Valley.

Kathmandu City was a natural choice for the introduction of electric vehicles for a number of reasons. Being situated in a Valley with a mild temperate climate, Kathmandu offered a unique setting for the introduction of zero emissions vehicles. The city is close to another city, Patan, and both are spread through an area about 12 km wide, enclosed by a ring road of only 35 km. The roads are narrow and the distances run by public transportation are short. With average traffic speed at about 20 km/hour in the city core, vehicles rarely accelerate beyond 40 km/hr. The roads are mostly level, with gradients varying from approximately 8% to 13%. As in many cities in South Asia, three-wheeled tempos provided the most appropriate low-cost means of public transportation.[34]

This introduction was appealing to Nepal in terms of its economic interests, too. At the macro scale, the EV industry was projected to bring cost savings and revenues to the nation. The country has clean hydropower electricity available in abundance. Electric

---

[32] Interview: Bimal Aryal, P.S. Joshi, Adam F. Friedensohn, D.B. Limbu, Hridaya Manandhar, and Ashok Pandey
[33] Interview with Peter Moulton.
[34] Cohen M. and Moulton P. 1998.

vehicles would utilize off-peak electricity, generating additional revenues for the government. The use of this indigenous electricity for transportation would also reduce the country's dependence on imported oil and cut expenditures on fuel. During the mid - 1990s, Nepal annually spent over US$ 80 million to import fossil-fuels (kerosene, petrol, diesel, and cooking gas) from overseas.[35]

The implementation of zero emissions vehicles would also improve air quality and reduce health costs. Global Resources Institute (GRI) estimated in 1995 that the cost of vehicle emissions in Kathmandu was at least US$10 million per year.[36] It was also estimated that a 10% increase in emission load due to traffic would impose an additional health cost of about US$ 75,000, while a similar reduction would lessen the cost by US$ 44,000.[37] In addition, the country wanted to boost its tourism industry. Because of the air pollution, the city was losing its charm to tourists. In 1993/1994, tourism accounted for about 4.1% of the GDP of Nepal and over 27% of total foreign exchange earnings.[38]

As the cities agreed to push the idea through experimentation, the chairman formed GRI, a US-based NGO, to undertake the conversion of Vikram tempos to electric vehicles. When GRI arrived in Nepal, it looked for other less polluting alternatives in addition to electric vehicles. The group visited Bangkok, Thailand, where the city had been testing a relatively low polluting liquid petroleum three-wheeler vehicle (LPG), known as " tuk tuk."[39] The Thai Ministry of Environment informed GRI that the LPG vehicles had considerable risk since there had been many cases of explosions. In addition, the vehicles were less polluting only if they were properly maintained, and vehicular maintenance was known to be poorly practiced in Nepal. Following the visit, GRI discarded the alternative of using LPG and fully concentrated on testing the conversion of Vikram tempos to electric vehicles.

---

[35] ..... "General Strikes in Nepal." July 8, 1997 <http://www.dnai.com/~figgins/generalstrike/asia/nepal.html>; Ministry of Finance. Economics Survey 1996/1997. 1997.

[36] Cohen, M. & Moulton, P. 1998.

[37] Cited in Baral et al. 2001.

[38] Tourism Development in Nepal: http://www.panasia.org.sg/nepalnet/economics/tourism.htm; Nepal: A country Study. "Tourism Nepal." http://lcweb2.loc.gov/cgi-bin/query/r?frd/cstdy:@field(DOCID+np0092.

[39] I have used the terminology tuk tuk interchangeably with LPG three-wheelers.

GRI built a prototype EV, the Safa Tempo, with initial funding of US$ 60,000 in September 1993. It then acquired US$ 497,000 funding from the National Association of State Development Agencies (NASDA)/US Asia Environment Partnership (USAEP), and undertook an elaborate two-year Electric Transportation Program to study the commercial and technical viability of operating electric three-wheelers in the Kathmandu Valley.

Although USAID's involvement at the time could be seen as a typical donor's interest in assisting the development of Nepal, there were other aspects to its involvement. Since it was not a priority of USAID to invest in the urban environment sector, two key factors seem to have spurred its interest.[40] First, implementing electric vehicle technology was topical at that time. California had already adopted the Zero-Emission Vehicles mandate (ZEV) as part of its Low Emissions Vehicle and Clean Fuel programs, and was beginning to explore the use of EV technology. Investing in such technology in Nepal would generate more information about the appropriateness and effectiveness of such technology. Because the effort came from an INGO as part of building cooperation between two cities at the municipal level, it did not take long to gain USAID approval for the grant.[41]

Prior to GRI's efforts, a group of Kathmandu-based engineers had embarked on a similar initiative. They had formed an Electric Vehicle Development Group (EVDG) and converted a Volkswagen Beetle to an electric vehicle.[42] Their efforts, however, did not focus on building the EV industry for public transportation. After the arrival of GRI, their efforts came to an end.

EV Demonstration Project: Electric Transportation Program

Initially, GRI aimed to convert all Vikram tempos to electric power. However, the life span of a Vikram tempo is only about 8-10 years. By the time GRI got interested in this

[40] Interview with Peter Moulton, GRI. According to him, USAID's major focus in Nepal was on rural development, health and family planning and infrastructure.
[41] Interview with Peter Moulton.
[42] Baral, A., Parajuli R., and Aryal B. 2000. Pp-7.

project, these vehicles were already 4-5 years old, some up to 7-8 years. It appeared more feasible to start with a whole new vehicle. Hence, the group set up a workshop and began building new electric vehicles under a two-year EV demonstration project, assembling various components imported from India, the U.S.A, and the U.K. A chassis and a manual-reversing switch were imported from India, a DC motor and controller from the UK while the body was made in Nepal. A charging station and battery exchange facility were established. The modest speed and range requirement made it possible to choose a simple EV technology based on a standard, proven D.C. motor and lead acid battery technology. With a fleet of seven electric vehicles, the project initiated operation on a route for technical demonstration for a period of six months.

The GRI project was two-pronged: first, examining technical and commercial viability, and second, planning for a favorable policy and commercial environment for EV implementation. The first aspect dealt with the performance and modification of the technology as well as projecting potential costs for the life of the EV vehicle. It conducted the performance demonstration for six months. The second aspect looked into creating an enabling environment for EV growth. According to Moulton, four major elements were involved: incentives for new industry; disincentive for polluting vehicles; public education about the environmental benefits of EV; and technical and business education to operators and investors.[43] The main goal of the effort was to enable EV to compete with other existing public transportation, in particular with diesel and petrol vehicles that provided a similar service.

Policy Breakthrough

Recognizing the need for a multi-dimensional approach to achieve its goals, project personnel worked closely with the Ministries of Finance, Transportation, and Environment, and Departments of Transport Management, Roads, Industry, and Tourism. They also worked with Nepal Electricity Authority, Valley Traffic Police, and Nepal Rastra Banks. In the process of garnering concrete support, project personnel met with

[43] Written interview with Peter Moulton.

the then-Prime Minister a couple of times.[44] The personal interest of the U.S. Ambassador helped put pressure on the government to adopt EV-supportive policies.[45] As a result, there was a major policy breakthrough when a favorable import tax, a VAT subsidy and the categorization of the industry as "nationally prioritized" were adopted by the national government.

Incentives: A series of consultations by GRI with the Ministry of Finance resulted in the Fiscal Act of 1995/1996 which provided incentives for EVs by reducing the import tax to 1% and exempting VAT for chassis, batteries, and other components to build electric three-wheelers or to convert diesel three-wheelers. These incentives also included a 5% import tax for body parts and 10% for all complete electric vehicles. This was very minimal, compared to a 20% tax on other electric goods, 60% for the importation of diesel or gasoline three-wheelers and as much as 160% for a four-wheeled vehicle. With all these incentives (1995), one could manufacture a Safa tempo at about US $5,500.[46] According to GRI, these incentives enabled electric vehicles to compete with other diesel and petrol vehicles, encouraging business people to invest in the EV industry. They also found the operating costs of an electric vehicle to be less than the operating cost of the Vikram tempo. [47] Although the operating costs of an electric vehicle was little more than the operating cost of the Vikram tempo, allowing the Safa tempo to charge 33% higher fare made it competitive with the Vikrams.[48] According to Moulton, the Safa tempo realized 17% higher profit than the Vikrams at higher fare.

---

[44] Interview with Peter Moulton and Marilyn Cohen.
[45] Interview with Peter Moulton and Marilyn Cohen.
[46] Cohen, M. & Moulton, P. 1998.
[47] Cohen, M. & Moulton, P. 1998.
[48] Cohen, M. & Moulton, P. 1998.

Table 3: Comparison of Operating Costs (1996 Figures)

Cost of electricity $0.055/kwh		Energy Consumption 0.20 kwh/km	
Operating Costs	Electric	Diesel	Petrol
electricity per km.	0.011		
Cost of batteries (2 sets)	1340		
km. Per 2 battery sets	45000		
Battery replacement cost per km.	0.03		
fuel per km.	0.04	0.025	0.057
maintenance per km.	0.004	0.01	0.01
Operating Costs	0.044	0.035	0.068

Electric "fuel" is electricity + battery replacement

Source: Cohen, M. & Moulton, P. 1998. Promoting Electric Vehicles in the Developing World. International Electric Vehicle Conference, San Jose, Costa Rica.

In addition, GRI succeeded in convincing the Department of Transport Management to allow registration and provide route permits for these tempos.

EV as "a nationally prioritized industry": Through GRI's work with the Ministry of Industry the EV industry also managed to extract further benefits from the national Industrial Enterprises Act (1993) which categorized all manufacturing industries dealing with energy efficiency, conservation, and pollution abatement as a "prioritized sector."[49] Being a prioritized sector industry, the EV industry received a 50% discount in its taxable income for a period of 7 years beginning from the date of production. With a view toward encouraging innovation, the EV industry was further entitled to an income tax reduction of 40% if it could diversify, expand, and modernize through reinvestment and modification. These legislative initiatives increased the appeal of the EV industry to the private sector.

[49] Baral, A., Parajuli R., and Aryal B. 2000. Pp-15

In order to promote prioritized sector industries, Nepal Rastra (National) Bank, the principal authorized regulatory and monitoring body of the banking sector, mandated all government and joint venture banks to allocate a portion of their investment (at least 12% of their total loan portfolio) to ventures in prioritized sectors. In the absence of this action, the banks would be required to pay fines. These could be avoided by investing in the EV industry. Having included EV under a prioritized sector industry, GRI succeeded in attracting the attention of national financing institutions. As a result, some banks including Nepal Banijya Bank and Nepal Agricultural Development bank became interested in providing loans at favorable interest rates for new companies as well as to help with the purchase of vehicles.

Handing over to the private sector

USAID required GRI to form private EV companies. Also, GRI had to hand over the demonstration fleet to such a company at the end of the test period. For this, GRI conducted presentations and discussions with businesses and potential investors about the economics and technology of electric vehicles. When the technological and financial viability of the EV technology had been established, two private companies, namely Nepal Electric Vehicle Industry (NEVI) and Electric Vehicle Company (EVCO) were formed and ready to bid for the property and rights. NEVI won the bid, establishing the first private EV industry in Nepal.

Criteria for the sustainability of the industry

In order for the EV industry to be sustainable, GRI recommended a vertically integrated business model in which an EV company builds, services, and operates its own vehicles with a fleet of at least 25 to 30 vehicles (See Figure 1). GRI's recommended business model (1996) was aimed at achieving both economies of scope and economies of scale. A company achieves economies of scope when it can make cost savings as a result of sharing inputs, production facilities, and the common administration over a variety of the closely linked activities that it performs. Economies of scale are achieved when the average unit cost of production declines as the quantity of goods/services increases in a company. Conceptually, in this model, a single company performs a variety of interrelated economic activities (at a certain minimum output) as opposed to relying on

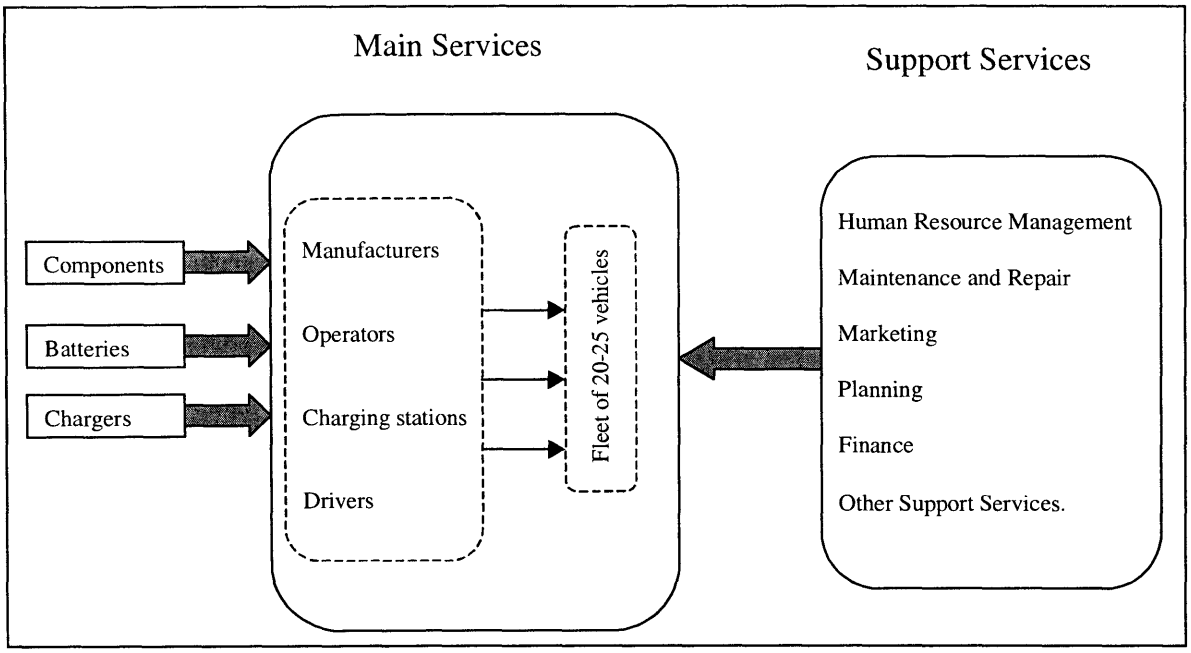
individual suppliers in the market.[50] This becomes even more important when the inputs are highly specialized products unavailable in the market, requiring large up-front costs to produce. For example, the early computer industry used this model in order to achieve economies of scope during its early phases because the market for critical components and technologies was underdeveloped (or non-existent); they were, at best, very expensive if acquired from outside the firm. Similarly, a company can offset the high upfront cost (input cost) and achieve economies of scale by producing a certain minimum quantity of outputs.

The EV industry was essentially a specialized assembling industry in which the up-front cost of investment was high. This was true for two reasons: first, the industry had yet to put in place its basic infrastructure, particularly charging stations and battery exchange facilities. So, whoever wanted to invest in the technology also needed to invest in building infrastructure either directly or indirectly. Second, the investors needed to acquire every input at high cost: the need to obtain components from overseas at cost, the need to obtain a vehicle at cost, the need to obtain batteries at cost, and the need to perform charging at cost. A company would already be paying a certain mark-up price to acquire these inputs and acquiring them through more than one distribution channel would raise the mark-up costs. However, at the same time, a company needs to earn certain minimum revenues to offset high upfront costs. According to Moulton, this could be achieved only by running a minimum number of vehicles which, in this case, was at least 25-30. The larger the fleet, the greater the profit.[51] The capacity to build, operate and service a fleet of 25-30 vehicles was assumed to be the minimum necessary to achieve the necessary financial return. In this model, resources could be shared to achieve cost savings and companies did not have to pay a profit to another company for acquiring vehicles, batteries, and battery servicing as well as maintenance and repair.

---

[50] Changqi Wu, Strategic. 1992.
[51] Interview with Peter Moulton.

Figure 1: Build, Operate and Service Model



Another important aspect of the recommended business model involved EV battery characteristics. The life span of EV batteries was predicted to be only 16-18 months for the purpose of calculation (actual life span specification is 22 months) and each replacement was calculated to constitute 80% of the operational cost and 20% of the cost of electricity.[52] This required operators to buy more than a year's worth of EV batteries upfront, at the same time generating revenues to save a small amount of money every day to make provision for the next set of lead-acid batteries after the expiration of the first batch.

In addition to business recommendations, the GRI project also stressed a number of technical recommendations regarding the sustainability of the industry. First, the need to soundly maintain and charge EV batteries was important to enable them to last for their full life span. How long the batteries lasted would determine the operating cost of Safa

[52] Cohen, M. & Moulton, P. 1998.

tempos. Second, the availability of skilled personnel, including charging personnel and drivers, would be crucial for the EV industry to sustain itself over the long run.

Phase II: Incremental Growth of the EV Industry (1997- 1998)

This phase is characterized by two events -- the growth of the private sector and the lobbying and advocacy of non-governmental organizations. The private sector took over the advancement of the industry, making possible the commercial operation of electric vehicles in Kathmandu. New entrepreneurs in the form of manufacturers, vehicle operators and charging station owners emerged. During this phase, many NGOs took part in advocating for EV technology and lobbying against the forces opposing EV growth.

Growth of the private sector

The Nepal Electric Vehicle Industry (NEVI), comprised of environmentalists, journalists, engineers and business people, became the first private sector company. NEVI, in general, functioned within the integrated business model, manufacturing, operating, and servicing its vehicles. The other company that emerged at the same time was Electric Vehicle Company (EVCO). EVCO focused more on the manufacturing aspects of the industry. These investors were motivated to make a profit, but at the same time they were eager to improve air quality in the Valley.[53] They differed greatly from the conventional group that had invested in fossil-fuel-operated vehicles in the country.

These companies hired the experts (technicians and engineers) who had been involved with the GRI's demonstration project. During 1997 and 1998, these two companies dominated the market. Aided by a number of incentives, in particularly the tax reductions and VAT exemptions mentioned above, these companies gradually expanded their production, charging facilities, and vehicle operation. These companies followed GRI's design and manufactured vehicles by assembling a number of imported and locally made components. As for batteries, each company dealt with the original equipment manufacturer, primarily Trojan Battery Company of the U.S. Both had their own

[53] Interview with Ashok Pandey, Ramesh Man Singh, P. P. Pokhrel, J.R. Goff, Adam Friedensohn, and Hridaya Manadhar.

charging facilities, drivers, and mechanics for maintenance and repair. Nevertheless, EVCO, right from the beginning, sought to decentralize by giving technical support to interested entrepreneurs to establish charging stations and operate vehicles. By the end of 1997, the two companies together had about 35 Safa tempos with 4 charging stations.

From 1997, the industry started developing more as a manufacturing and market industry in which vehicles were sold to individual entrepreneurs. Encouraged by the reduced-rate financing available from the bank and the favorable business prospects of EVs, a new set of entrepreneurs entered the EV industry, as *individual operators*, creating a demand for more Safa tempos. This enabled NEVI and EVCO to solidify their role as manufacturers. However, the charging stations of manufacturers alone were insufficient to service the gradually expanding number of Safa tempos. By the end of 1998, in response to this demand, yet another type of entrepreneurs emerged – *charging station operators.*

As more banks saw it as a good option to include EV as a priority investment and to make their portfolios look better, these initiatives encouraged an increasing number of entrepreneurs to invest in Safa tempos. For them, investing in EV also was desirable because the EV industry was a transportation industry (known to be generally profitable), and the investment was located in urban areas making it easier to appraise.[54] Two of the three banks, Rastriya Banijya Bank and Nepal Agricultural Development Bank, provided loans of 70% of the total cost of the vehicle with a collateral of the vehicle itself at the reduced interest of 14-16%. (Generally, the bank imposes 18% interest.) A 100% loan could also be obtained with additional collateral. This attracted investors of all kinds, low income, middle income, and high income.[55]

As a result, there were 110 Safa tempos on the roads by the end of 1998, up from 15 in early 1997, and there were 9 charging stations, up from 2. By halfway through this phase, the manufacturing companies and operator-entrepreneurs had formed their own trade associations, namely Electric Vehicle Manufacturing Association Nepal (EVMAN) and Clean Locomotive Entrepreneurs' Association of Nepal (CLEAN).

---

[54] Lundgren, A. February 1999.
[55] Interview with Bimal Aryal.

As they gained popularity in Kathmandu, EVs faced opposition from groups who owned Vikram tempos and other fossil fuel vehicles.[56] One such source of opposition came from the Valley Traffic Police (VTP) who reportedly owned the majority of polluting tempos (registering under the names of their families).[57] Being the main enforcing agent of vehicular standards and traffic regulations, they found the slow speed of Safa tempo an easy target. An incident in October 1998 received much publicity when the VTP seized a number of Safa tempos for violating traffic rules and adding to congestion despite the fact that Vikram tempos contributed equally to the congestion problem.[58]

NGOs

As this phase evolved, the opposing forces started to coalesce. Although NGOs like Explorer Nepal had been active for some time in educating the public about air pollution, the NGOs' efforts on behalf of clean air intensified only after the arrival of Safa tempos. The environmental movement was new at the time and vehicular pollution was a growing issue in Nepal. The NGOs were drawn to this issue and started the clean air campaign. Realizing that the polluting Vikram tempos could be replaced entirely by Safa tempos, the NGOs reorganized their agenda. They adopted a clear goal for promoting alternative fuel vehicles like the Safa tempos in the Kathmandu Valley and the banning of all Vikram tempos or "smoke-belching vehicles." This was the beginning of a struggle between Safa tempos and the Vikram tempos.

In this process, a number of new NGOs committed to EV advocacy emerged. One highly visible one was Martin Chautari. This group initiated something called the Electric Vehicle Promotion project with funding from the Renewable Energy Program Support Office of Winrock International[59] in early 1998. The project aimed to eliminate the bottlenecks in the EV industry. Martin Chautari partnered with media groups to increase pressure on the concerned authorities through media campaigns, public forums, and press

---

[56] Lieberman, Joseph. 2001. http://www.eugeneweekly.com/03_22_01/news.html#news3

[57] Interview with Bimal Aryal and Peter Moulton; Lieberman, J. 2001. http://www.eugeneweekly.com/03_22_01/news.html#news3; The Kathmandu Post. November 1, 1998

[58] The Kathmandu Post. October 29, 1998.

[59] An International Non-Governmental Organization whose headquarter is in the U.S.A.

conferences. There were other supporting NGOs, some new and some old: LEADERS Nepal concerned with research and air quality monitoring activities; Pro Public worked through litigation; and Nepal Forum for Environmental Journalism through media and seminars. At times, these NGOs resorted to aggressive acts. The NGOs such as Abhiyan Group and the Explorer's Nepal took to the streets when the government failed to take action against Vikram. While some NGOs were primarily concerned with advocacy, others such as the Center for Renewable Energy and Alternative Energy Promotion Center became involved in research and development about renewable energy technologies.[60]

Table 4: Environmental NGOs and their Activities

Full Name	Acronym	Date established	Activity
Global Resources Institute (INGO)	GRI	1993	Research & development and technology innovation
Explorer Nepal		1994/1995	Air quality lobbying and advocacy
Abhiyan Group		NA[61]	Air quality lobbying and advocacy
LEADERS Nepal		NA	Air quality monitoring and Advocacy
Pro-Public		NA	Environmental Litigation
Nepal Environment Forum for Journalists	NEFEJ	NA	Environmental Education
Center for Renewable Energy		NA	Research and development for clean energy
Alternative Energy Promotion Center		NA	Research and development for clean energy
Martin Chautari (Electric Vehicle Promotion Project)	MC	1998	EV advocacy and lobbying
Renewable Energy Program Support Office/Winrock International	REPSO	NA	Funding support for Martin Chautari
Clean Energy Nepal		2000	Advocacy, lobbying and networking

Although NGOs were unable to coordinate among themselves, their initiatives helped build up pressure on the government. Eventually, Vikram tempos were banned at the beginning of Phase III.[62]

[60] Aryal et al. 2000.
[61] NA: Not Available

Kathmandu Metropolitan City

The Kathmandu Metropolitan City (KMC) government also joined the lobbying force in early 1998. Under the Clean Air Campaign, KMC championed non-polluting vehicles such as the Safa tempo. The campaign included, among other things, the demand for and enforcement of vehicular emission standards, the phasing out of all non-complying vehicles, and environmental awareness among the residents. In fact, KMC claims to be the first agency to have asked for the ban of Vikram tempos in the Kathmandu Valley.

However, apart from making pronouncements and taking several actions to promote Safa tempos, the Kathmandu city government did not take as many concrete steps as it wished.[63] The two key barriers that the city points to are: the promotion of EV is under the transportation sector and does not fall within municipal jurisdiction; and second, the city lacks authority to implement the program (although they are given responsibilities under the Decentralization Act 1990).[64]

Electricity Subsidy

The end of this phase also saw another incentive for the Safa tempo that resulted from the lobbying efforts of both the EV stakeholders and NGOs.[65] In late 1998, the Nepal Electricity Authority, a semi government body, provided electricity subsidies for the EV industry. Thus, the Authority reduced fuel costs for Safa tempos by lowering the electricity price by approximately 40% per unit (from NPR 5.10/unit to 3.10/unit, later it was from NPR 6.90/unit to 4.00/unit).[66] Until then, the charging stations (similar to petrol stations) had been paying the same rate as other industry users who use electricity at peak hours. The E.V. industry argued that they should be eligible for further discounts because battery charging used off-peak, otherwise wasted, electricity.

---

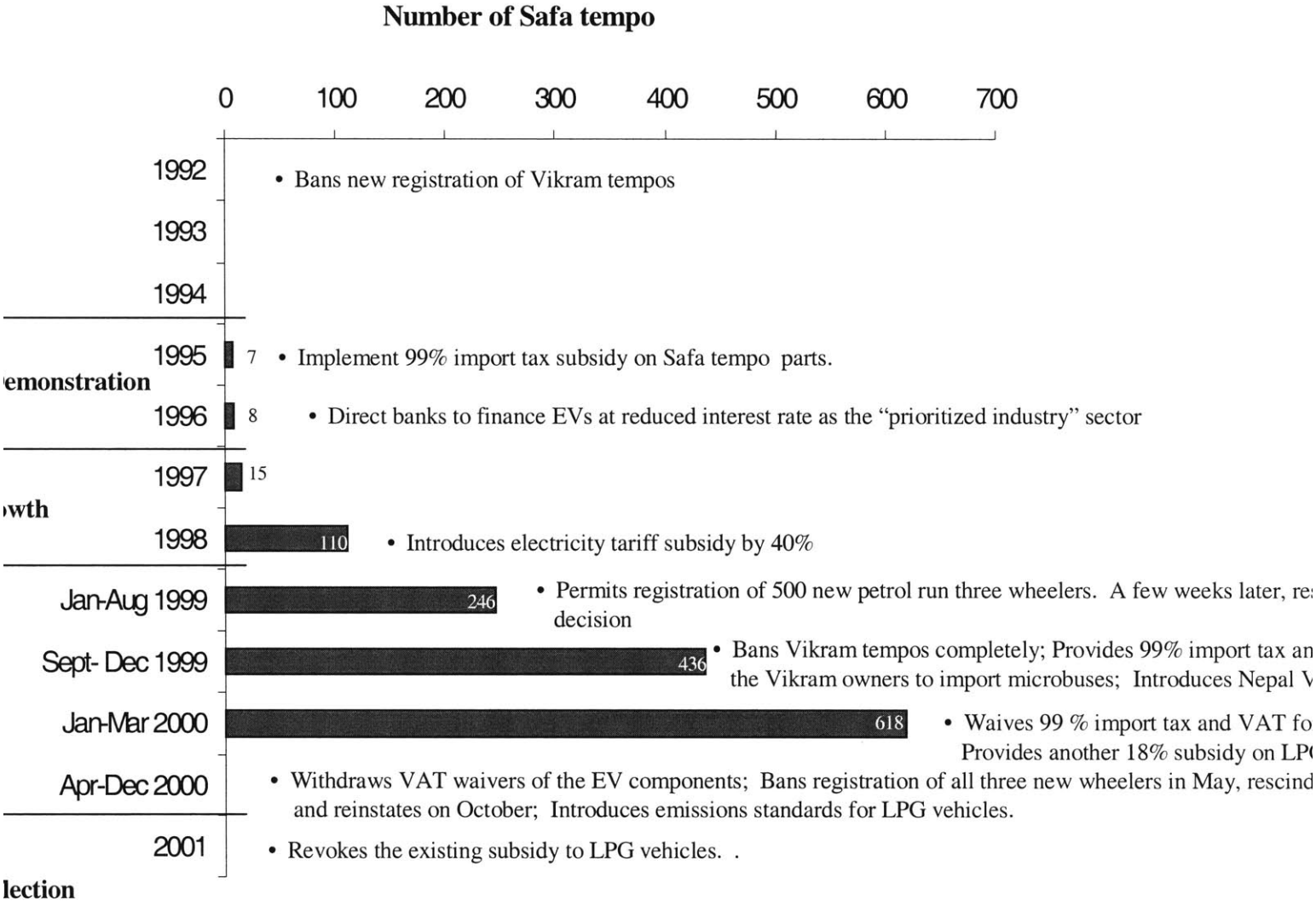
[62] Aryal et al. 2000.
[63] Interview with Mr. P. S. Joshi. He is a National Co-Director of the Kathmandu Valley Mapping Programme of Kathmandu Metropolitan City.
[64] Interview with P.S. Joshi; Baral, A., Parajuli R., and Aryal B. 2000. Pp-7.
[65] Interview with Bimal Aryal.
[66] Baral et a. 1999; Using the exchange rate of that time.

Emergence of Danish International Development Agency's Interest (DANIDA)

USAID was not interested in providing long-term support for the development of EV in Nepal because of its low priority in investing in the urban environment sector.[67] However, USAID's initial investment attracted the attention of another donor, DANIDA. In 1999/2000, DANIDA was willing to provide a grant to expand EV operation.

[67] Interview with Peter Moulton.

Figure 2: Government's Decisions and Electric Vehicles Growth in Kathmandu



Phase III: Proliferation (1999-2000)

Phase III was a very intense phase in the history of EV development. This phase saw a rise and then a fall in the EV industry. This period was characterized by inconsistent government policy both aiding and hurting the health of the EV industry, the intensification of advocacy and lobbying, and the emergence of problems within the EV industry. Both opposing interest groups and NGO advocates were involved. The EV stakeholders enjoyed a major boom in the first half which was followed by a slump later on. By the end of this phase, the EV industry was already failing.

Rise in the EV industry

Successful lobbying leads to more EV-supportive policies

This phase saw important contributions from NGOs in advocacy and lobbying for EV-supportive legislation and policies. Because of powerful EV-opposing groups and their influence on government policies, however, the NGOs spent most of their time fighting with the government on the policy front.

One such event was the decision by the Department of Transport to allow the new registration of 500 polluting gasoline three-wheeled vehicles (cabs) in January 1999.[68] The EV advocates saw this as a blow to EV expansion. In response, Martin Chautari along with other environmental NGOs organized extensive protests. This helped pressure the government to revoke the decision a few weeks later.[69] This incident made NGOs more alert and increased their aggressiveness.

In August 1999, the government made two major (and, arguably, contradictory) policy decisions critical to the development of EV in Nepal. On the one hand, the operation of Vikram tempos was completely prohibited in the Kathmandu Valley, causing a gap in

[68] Interview with Bimal Aryal; Aryal et al. 2000.
[69] Interview with Bimal Aryal; Aryal et al. 2000.

public transportation.[70] It was an accomplishment for the Kathmandu Valley residents who had waited eight years to eliminate Vikram tempos after the Valley banned registration in 1992. According to Martin Chautari, the combination of litigation in the Supreme Court, as well as protests against Vikram tempos through media, rallies, and signature campaigns, finally compelled the government to announce complete prohibition of the Vikram tempos. This boosted the confidence of the environmental NGOs and encouraged them to focus on yet another agenda item: pushing the government to regulate polluting vehicles by setting more stringent standards.[71]

On the other hand, the ban also provided for the owners of Vikram tempos to receive 99% subsidies in custom tax and VAT exemption if they wished to import petrol- or LPG-operated microbuses that had the capacity to handle 10-14 people. Many critics believed that such measures were detrimental to the promotion of EV growth; rather than replacing Vikram tempos with zero emissions Safa tempos, the government opted to replace them with microbuses, which too were polluting, although less so than Vikrams.[72]

At first, the bureaucratic red tape delayed the entry of these microbuses by 6 to 7 months.[73] This created a severe gap in the supply of public transportation (the key segment served by Vikram tempos), giving opportunities for the EV industry to expand.

The NGOs' continuing efforts also contributed to the Mass Vehicular Standards regulation issued by the Ministry of Population and Environment (MoPE) in December 1999. This emphasized the importance of zero emissions vehicles (ZEV) like the Safa tempo and set standards carbon monoxide, hydrocarbon and oxides of nitrogen standards for different types of vehicles.[74] Although the standards aimed to regulate the importation of polluting and sub-standard vehicles, air quality advocates reported no benefit from this move because of the lack of proper enforcement.

---

[70] Interview with Bimal Aryal, Bikash Pandey, and many others. Almost all interviewees mentioned this gap.
[71] Interview with Bimal Aryal; Aryal et al. 2000.
[72] Interview with Bikash Pandey.
[73] Interview with Ashok Pandey, P.P. Pokhrel, and Ramesh Man Singh.
[74] MoPE. 2000. Pp-82.

Boom in the EV industry

Given the opportunities created by the elimination of about 640 diesel tempos from the Kathmandu Valley, more new manufacturers and entrepreneurs emerged. Some people who had once worked in the GRI project and later in NEVI and EVCO also became entrepreneurs, manufacturers and operators of electric vehicles.[75] Since EVs were manufactured within the Kathmandu Valley, the number of EVs immediately rose from *246 to over 600* within six months of the ban. The Nepal Electric Vehicle Company (EVCO) manufactured 200 vehicles and NEVI produced about 250.[76]

By late 1999, there were five manufacturing companies in operation and more than 350 entrepreneurs, and the numbers were still growing. Among the individual operator-entrepreneur, over 76% were one-owner-one-vehicle entrepreneurs, [77] most of whom leased their vehicles to drivers and collected a daily payment, making *drivers additional key actors.* Many of these drivers had previously engaged as drivers of gasoline- or diesel-powered vehicles. As for the manufacturers, they needed to be assured that they would have access to the necessary infrastructure, particularly charging stations for battery and battery banks. So, they installed and expanded charging stations to provide charging services for their customers.

DANIDA's support to expand EVs: As the private sector continued to expand, Danish International Development Agency's (DANIDA's) interest in the EV sector grew. Since DANIDA had already allocated a substantial amount of aid allocated for environmental management in Kathmandu Valley, the EV sector was a sensible area for additional support. Hence, DANIDA introduced the Electric Vehicle Pilot Promotion Project at the end of 1999, contributing to the boom.[78] The project provided funds to new EV entrepreneurs through the Ministry of Population and Environment (MoPE) in 1999/2000. Support included soft loans at a 5% interest rate to 48 new Safa tempos and 2 charging stations. In total, DANIDA granted about US$ 364,000 (NPR 25 million).[79]

---

[75] Aryal, B., Baral, A. and Parajuli R. 2000.
[76] Interview with Ashok Pandey, "Geevan" Goff, and P.P. Pokhrel.
[77] Devtec Nepal P. Ltd. December 2001.
[78] DANIDA. July 2000; Interview with Sharad Neupane, DANIDA.
[79] DANIDA. July 2000.

Repayments by borrowers were intended to be deposited in the Environmental Protection Fund of the Ministry of Population and Environment. Like GRI, DANIDA initially intended to convert 100 Vikram tempos to electric power by providing soft loans to Vikram operators. This failed to motivate the operators, however, because: 1) there was no disincentive or penalty for operating Vikram tempos; 2) the opportunity cost of conversion and operation was too great for the owners because the Vikram market was still doing well; and 3) income would be less from the converted tempo because of its reduced passenger capacity and increased fuel cost (battery charging).

By the end of 2000, the Bagmati Zone Transport Management Office (TMO) showed 618 electric vehicles registered in the Bagmati Zone, among which 595 were passenger vehicles with 23 owned by private or government organizations.[80] There were about 36 charging stations servicing these Safa tempos. Some of these stations also provided repair and maintenance services. Three other individual EV maintenance and repair workshops also contributed to providing this type of services.[81] As more charging stations sprang up, some entrepreneurs saw opportunities to manufacture chargers. They established *charger manufacturing industries*, the first of their kind in Nepal. There are now four companies supplying chargers: they are Lotus Energy, Kulayan Battery Industries, Shiva Lal and Digitech.[82] Previously, the charging station owners had to import chargers from either India or the U.S. In August 2000, a local company (Hulas Motor) manufactured the chassis for a Safa tempo for the first time in Nepal. This locally made chassis was $US 500 cheaper than the imported one.[83]

---

[80] Devtec Nepal P. Ltd. December 2001.
[81] Devtec Nepal P. Ltd. December 2001.
[82] Interview with Bimal Aryal.
[83] Martin Chautari. AFV News. August 3, 2000.

Table 5: Size of EV Industry

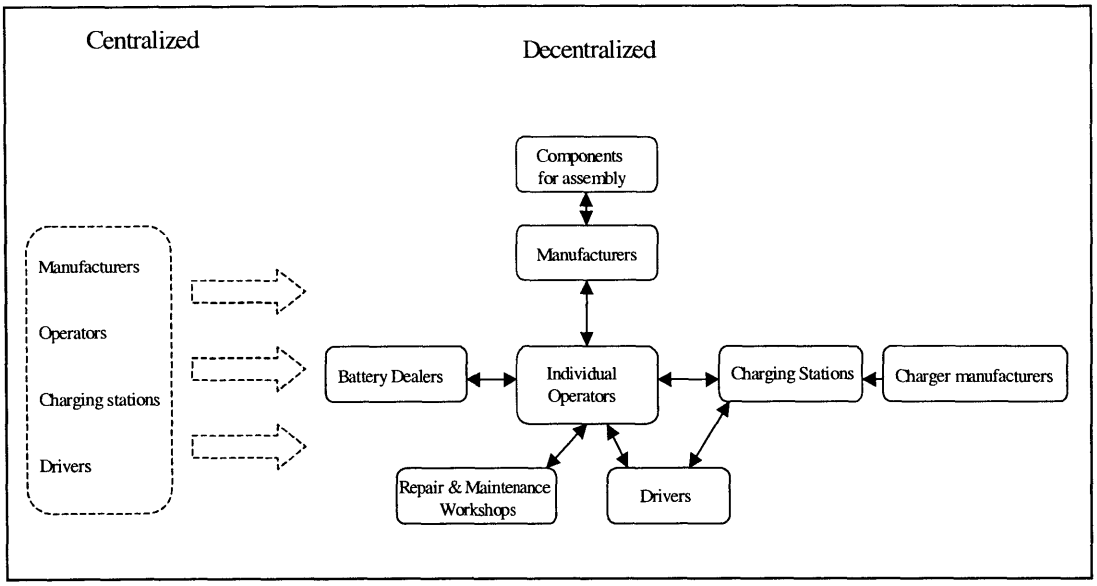
EV Stakeholder	Year Established	Quantity
Manufacturing Companies		
Nepal Electric Vehicle Industry (NEVI)	1996	223 (vehicles mfd.)
Electric Vehicle Company (EVCO)	1996	218
Green Electric Vehicle	1998	80
Green Valley Electric Vehicle	1999	63
Bagmati Electric Vehicle Co.	1999	14
Operators	1996-2000	430
Charging stations	1999/2000	36
Charger Manufacturers	2000	4
Lotus Energy		
Kulayan Battery Inds. Pvt. Ltd.		
Shiva Lal		
Digitech		
Battery Dealer	1996	2
NEVI	(Only until mid 2000)	
Lotus Energy		
Maintenance and Repair Workshops	2000	3

For the supply of EV batteries, independent EV battery dealers emerged as suppliers fulfilling the most fundamental need of EV operation. Since its inception, the EV industry had continued using the U.S.-manufactured Trojan battery, a deep cycle lead-acid battery. Trojan remained a preferred choice for the operators because they are inexpensive and readily available.[84] At first, there were two dealers supplying the batteries, Lotus Energy (sister company of EVCO) and NEVI. However, later, the Trojan company made Lotus Energy its sole representative. Since then, there had been only one dealer supplying EV batteries. This created a monopoly in battery distribution, often causing a shortage of batteries.[85] Also, there were other types of dealers, supplying spare

[84] Interview with all of the private actors.
[85] Interview with Ashok Pandey, Ramesh Man Singh, Hridaya Manandhar, P.P. Pokhrel, and Dick Bhola Rai.

parts for EVs. There were seven of them and most served petrol and diesel vehicles primarily and showed limited commitment to the EV industry. Since they did not buy from the original equipment manufacturers of EV components, the parts they supplied were often substandard.[86]

Figure 3: Decentralized EV Industry



Creation of a Multi-million dollar industry: By 2000, the industry had already decentralized with various functions operating separately (Figure 2). Together, they had secured a total investment of US$ 59 million (NPR 450 million).[87] A high proportion of financial support for individual entrepreneurs came from banks, and some through Danish International Development Agency's (DANIDA) Electric Vehicle Pilot Promotion Project.[88] The charging stations alone attracted over US$ 470,000 (NPR 36.8 million) from the private sector.[89] Among these charging stations, only 23 percent were financed through loans, including two which received government loans subsidized by DANIDA.[90] All manufacturer investment came from the private sector.[91]

---

[86] Interview with Ashok Pandey, Ramesh Man Singh, Hridaya Manandhar, P.P. Pokhrel, and Dick Bhola Rai.
[87] Martin Chautari. AFV News. March 1, 2001.
[88] Interview with Bimal Aryal.
[89] Martin Chautari. AFV News. March 16, 2000.
[90] Martin Chautari. AFV News. March 16, 2000.

The EV industry generated substantial economic benefit for the government. According to one estimate, the industry generates about US$ 272,000 (NPR 20 million) in revenues annually for the Nepal Electricity Authority.[92] In addition, the industry provides direct and indirect employment to 6000 people.[93]

Toward Organization: By 2000, three main organizations representing the EV industry were well established in the private sector: Nepal Electric Vehicle Manufacturing Associations (EVMAN), representing EV manufacturers in Nepal; the Clean Locomotive Entrepreneurs Association of Nepal (CLEAN), representing owners of EV; and the Nepal Electric Vehicles Charging Association (NEBCA), representing EV charging stations. In addition, the EV drivers formed an association of their own. These associations lobbied for their relevant interests; CLEAN for parking and loading zone facilities and new routes; NEVCA for reduction in electricity tariffs; and EVMAN for more import subsidies. Despite the three essential functions, the associations had little coordination among them.[94] This remained the case until the end of 2000 when the EV stakeholders formed Electric Vehicle Association Nepal as an umbrella organization.

Table 6: EV Associations

Full Name	Acronym	Date established	Representation
Clean Locomotive Entrepreneurs Association of Nepal	CLEAN	1999	Operator-entrepreneurs
Electric Vehicle Manufacturing Association of Nepal	EVMAN	1999	Manufacturers
Nepal Electric Battery Charging Association	NEBCA	1999/2000	Battery charging station owners
Electric Vehicle Association Nepal	EVAN	2000/2001	All of the above

[91] Interview with Ashok Pandey, Ramesh Man Singh, Adam Friendensohn, and P.P. Pokhrel.
[92] Devtec Nepal P. Ltd. 2001. Pp-25
[93] Yogi, Bhagirath. June 9, 2000.
[94] Interview with all the private actors and Bimal Aryal.

Reversal of governments' policies

While the EV industry was enjoying a boom, the Liquid Petroleum Gas three-wheeled vehicles (tuk tuks) received similar preferential treatment from the government. Although gas-powered vehicles were already included under the category of "pollution free" vehicles (like electric vehicles) in Fiscal Policy 1995, it was only after the ban that this provision actually began to have influence.[95] The LPG three-wheelers also became eligible for the 99% custom tax and VAT waiver. This decision came despite GRI's 1995 warning to the government that the LPG three-wheelers posed safety and pollution risks when not properly operated and maintained.[96] The perverse effect of these two measures was that both EV and LPG tuk tuks were running on the roads as "pollution free vehicles." No standards or testing were deemed necessary to distinguish among these vehicles.

The LPG tuk tuks expanded to meet the demand for public transportation. Fortunately for LPG vehicles, which used LPG cylinders intended for cooking purposes, the Nepal Oil Corporation provided a subsidy of about 18% for the purposes of household use of LPG.[97] Capitalizing on this double subsidy, including the VAT and tax exemption, LPG vehicles started proliferating, increasing from less than 50 in early 1999 to 600 by 2000. This put EVs at a great cost disadvantage.[98]

More trouble arose for EVs with the emergence of government support for microbuses. Both tuk tuk and Safa tempo lost business. The microbuses are fast, comfortable and apparently look better than tuk tuk or Safa. The sudden surge of microbuses (to about 600), involving both LPG and diesel-power, instantly filled the transportation gap. Now

---

[95] Ministry of Finance. Budget Speech (Fiscal Year 1995/1996). 1995/1996.
[96] Interview with Peter Moulton.
[97] Interview with Bimal Aryal.
[98] Interview with Bimal Aryal, Ashok Pandey, Bikash Pandey, Adam Freidensohn, "Jeevan" Goff, and many others; Martin Chautari. AFV News. March 1, 2001.

Safa tempos were thus competing with two different types of vehicles that generated more pollution but got the same government subsidy.

By this time, the government's double standard had become evident. On the one hand, Safa tempos had been getting preferential treatment, while on the other, the same treatment was also afforded to other, environmentally inferior, vehicles. In mid-2000, the government revoked the previously granted VAT exemption privilege for the components of Safa, arguing that these components were also imported for other non-EV purposes.

NGOs lobbying against Liquid Petroleum Gas (LPG) vehicles and microbuses

These decisions placed environmental NGOs in confrontation with the government. Their EV advocacy escalated to a new level. No sooner did the NGOs' fight against Vikram come to an end with the complete Vikram ban, their struggle against LPG Tuk Tuks and microbuses began. Initially, the NGOs thought LPG was another alternative form of clean transportation. Although LPG is used in many countries as a clean fuel, the LPG technology adopted in Nepal was not as clean because: 1) many LPG vehicles in Nepal were converted from petrol-based internal combustion engines, producing a substandard engine (both three-wheeler and microbuses);[99] 2) even the newly imported LPG vehicles were not of high quality; and 3) a substandard cylinder, originally intended for cooking purposes, although inappropriate, was used as a fuel tank.

NGOs directed their attention to the LPG vehicles only after a significant number of LPG vehicles had already entered the market. Pro Public, on behalf of NGOs, filed a suit against the government (the Ministry of Transport/Department of Transport Management) for allowing LPG vehicles to operate without emission standards.[100] In November 2000, the government set standards for LPG, which were as same as for petrol vehicles (a limit of 3% of CO by volume). This implied that LPG vehicles were no better than gasoline vehicles that were not non-polluting.

---

[99] The conversion practice had been banned in India.
[100] Martin Chautari. April 27, 2001.

Allegation of battery pollution

In the mid 2000, the supporters of LPG vehicles used different media, particularly newspapers and dailies, to launch a campaign against Safa tempo. They alleged battery pollution. This attempt to undermine the clean image of the Safa tempo was successful.[101] The EV supporters countered by claiming that EVs accounted for less than 7% of all batteries wasted in Nepal and that others came from fossil-fuelled cars, trucks and buses.[102] They further maintained that EV batteries had resale value, each costing at US$ 7.09 – 9.93 (NPR 500 –700) and had been in great demand in India. The expired batteries were collected in charging stations and sold to scrap dealers who then took them to India. Also, some expired batteries were used for other low current applications such as for solar panels, computers, and lighting.[103]

Loss of income by entrepreneurs

Since mid-2000, entrepreneurs began to complain about the loss of income: their batteries gave low ranges of batteries; their vehicles frequently experienced breakdowns; and their vehicles also started to lose passengers to cheaper microbuses and LPG three-wheelers.[104] Many operator-entrepreneurs claimed that batteries which were supposed to last for 21-22 months started to deteriorate from the 13th month on, generating low ranges.[105] By the end of 2000, the batteries of many Safa tempos expired. Some owners stopped operating because the vehicle owners had not saved enough money to buy new batteries which cost nearly US$1,900. Even those who were able to buy did not obtain batteries in time.[106] According to them, the battery dealers did not deliver the batteries in time.

Meanwhile, some owners faced costly vehicle breakdowns because many of the components had to be imported from overseas for repair and maintenance. For example,

---

[101] Martin Chautari. July 2001.
[102] Martin Chautari. July 2001; Interview with Adam Friedensohn, Bikash Pandey, Hridaya Manandhar, and Bimal Aryal.
[103] Eisenring, M. July 2000.
[104] Interview with Megh Nath Rijal, Ramesh Man Singh, Dick Bhola Rai, Ashok Pandey, and Adam Fridensohn.
[105] Interview Megh Nath Rijal, Ramesh Man Singh, Bimal Aryal; Markus, M. July 2000.
[106] Interview with Ashok Pandey, Hridaya Manadhar, and Bimal Aryal.

if the controller broke, owners had to spend about US$ 650.[107] In some cases, the mechanics would not identify the problems accurately.[108]

In the transportation market, the Safa tempo charged an average fee of US$ 0.30 to 0.50 higher than their competitors.[109] As a result, the operators began to find their vehicles running without enough passengers, losing a daily income.[110]

Human resources needs

By the end of 2000, the EV industry constituted skilled manpower in manufacturing companies less than 20 % of the total employees and in charging stations less than 30%.[111] Many operator-entrepreneurs who leased out vehicles had hired drivers who previously drove Vikram tempos. Despite important continuities in the initiatives of the private sector and NGOs in this phase, there were not significant changes in the technology and the supply of skilled manpower.[112]

On the positive side, some NGOs emerged to respond to the deficiency of skilled drivers at the end of this phase. A number of NGOs such as Network for Environmental Development, "Samuhik Sewa" and "Mahila Manakamna Driving Center" started providing training to EV drivers.

Ban on the new registration or the Safa tempo

By mid 2000 only six months after the displacement of about 600 Vikram tempos, there were 1800 new vehicles consisting of Safa tempos, tuk tuks, and microbuses, providing 23%[113] of the public transportation. In Kathmandu Valley, public transportation consists of three types of vehicles: minibus, trolley bus, and three-wheeled tempo. Suddenly, the

---

[107] Interview with Ashok Pandey
[108] Interview with Hridaya Manandhar, Dick Bhola Rai, and Puskal Rana.
[109] Devtec Nepal P. Ltd. December 2001.
[110] Interview with Megh Nath Rijal, Ramesh Man Singh, and Dik Bhola Rai.
[111] These figures were obtained by extrapolating the data given in Devtec (2001).
[112] Interview with "Jeevan" Goff, Hridaya Manandhar, and Ramesh Man Singh.
[113] Cited in Pradhan, Naresh & Broersma, Klaus. November 2001.
In 2000, Department of Transport Management showed the following number of vehicles registered in Bagmati Zone (which primarily represents the entire Kathmandu Valley): 1,640 buses, 1690 minibuses, and 4500 three-wheeled tempos (consisting of both gasoline and electric).

surge of new vehicles generated an oversupply.[114] The Department of Transport Management believed that these numbers were too great for the roads' carrying capacity, causing unnecessary traffic congestion and pollution.[115]

Without substantiating this observation with a study, the Ministry of Labor and Transport Management made a decision to prohibit the registration of all new three-wheeled vehicles within the ring road in May 2000.[116] For electric vehicles whose primary market was within that perimeter, the decision was a setback. Many EV advocates including environmental NGOs, Kathmandu Metropolitan Corporation, Tourism based Hotel Association Nepal, the Danish Embassy, and the US Embassy strongly opposed the decision.[117] Of particular note was that the Danish Embassy threatened to suspend its Environmental Sector Program Support (ESPS) to which it had committed US$ 766,200[118] to the Ministry of Population and Environment to help in the capacity building of the EV industry to assist in EV promotion.[119] The government was unable to handle these criticisms and withdrew its decision within seven days of issuing the change.[120] However, six months later the DOTM claimed that there were 25000 more vehicles than the carrying capacity of the road of the Kathmnadu Valley could handle.[121] They then reinstated the registration ban, extending it to all four-wheelers and three-wheelers. This brought the production of all Safa tempos to a complete halt in October 2000, undermining the confidence of entrepreneurs in the EV industry.

The EV industry fails to establish itself in the public transportation market

By the end of this phase, the EV industry had failed to establish itself in the transportation market of Kathmandu. Because of the registration ban, vehicle production completely stopped and the value of the industry had started to fall. The market value for a second-hand vehicle went down to below US$ 2,011 (NPR 150,000) compared to the

---

[114] Interview with Sushil Agrawal, Bikash Pandey, Ashok Pandey, and Bimal Aryal; Sushil Agrawal is a Technical Director in the Department of Transport Management.
[115] Interview with Sushil Agrawal.
[116] The Kathmandu Post. June 3, 2000; Martin Chautari. AFV News. October 26, 2000.
[117] The Kathmandu Post. June 3, 2000
[118] Based on the exchange rate of October 2000, 1 DKK = 0.13 US$.
[119] The Kathmandu Post. June 3, 2000;
[120] Interview with Bimal Aryal, Martin Chautari; Martin Chautari. October 26, 2000.
[121] Pandey, Ashok R. AFV News. November 9, 2000.

original first-hand price of US$5,230 (NPR 390,000).[122] Having 10% depreciation per annum with a life span of 10 years and salvage value of US$1,204 (NPR 90,000), this second-hand value was lower than the depreciated value.[123] Public interest in EV dropped quickly.

Phase IV: Learning and Reflection (2001- Spring 2002)

Phase IV saw the end of further growth of the three-wheeled Electric Vehicles in Kathmandu. Although this phase does not fall under the scope of my analysis, I have attempted to discuss these on-going initiatives as lessons learned from the EV development experience. This phase may prove to be a reflective and remedial phase in which the EV stakeholders learn from and act on the lessons of the past. Already, new realizations are evident: EV stakeholders have realized the need for different management styles and have proposed a number of management schemes, including a battery-leasing system. The government has begun to take corrective measures by revoking its subsidy for LPG vehicles. More and better support networks are also emerging, with NGOs joining the Coalition for Clean Environment and DANIDA working to strengthen the EV industry through EV institution building, human resource development, and research and development. NGOs are expanding their domain too, with Martin Chautari currently helping with research to extend battery life. I have briefly outlined some of the activities that have occurred during this current phase:

- The joint effort between the Valley Traffic Police and the NGO Clean Energy Nepal to test LPG vehicles has resulted in building evidence to prove the higher pollution level of LPG vehicles, consequently leading the government to formulate new standards and remove subsidies for these vehicles. The government withdrew 99% import tax and VAT exemption at the end of 2001.

---

[122] Eisenring, M. July 2000; Interview with Megh Nath Rijal, Dick Bhola Rai, Ramesh Man Singh, Raju Palanchowki, and P.P. Pokhrel.

[123] Figures based on the calculation done by Raju Palanchowki, Researcher, Martin Chautari; Eisenring Markus. 2000.

- The NGO Himalayan Light Foundation has begun a pilot program to introduce a four- wheeled electro bus in the Valley. The British Embassy granted the funding of US$ 96,000 for the project. The vehicle is waiting for its registration as a passenger vehicle because of its original entry to Nepal as a cargo vehicle from the U.K.

- DANIDA started Environmental Sector Program Support (ESPS) with the Ministry of Population and Environment. This support aims to strengthen EV-related associations and address the issues of battery life, battery disposal, and human resource development through R&D and training. The project has established an Institute of Environment Management to train new EV drivers, charging stations personnel and EV mechanics.

- NEVCA initiated a battery leasing system by creating a fund of US$ 77,000 to supply EV batteries for operators. The battery-leasing scheme, more precisely a lease-to-own program, is the initiative of NEVCA and consists of a group of charging stations owners and operators. The operators or vehicle owners have to pay either a 30 or 50% down payment to participate and pay the rest with a loan from the fund at 7% interest and with a payback period of 13 months.

Part II: Analysis of Obstacles

The EV technology in Kathmandu had a successful start as well as promising growth for some time with the efforts by the private sector, environmental NGOs, USAID and DANIDA as well as the support from the government. Yet the EV industry began failing only six years after its introduction: the production went down to zero and the cost of a second-hand EV fell below its depreciated value; the EVs lost their competitive advantage to LPG vehicles and microbuses; entrepreneurs began facing technological and management problems. Like many new technologies, EV technology development also met many obstacles. Some obstacles were overcome: for example, the need for building infrastructures such as charging stations, manufacturing companies, and charger manufacturers. Some were not. A number of major obstacles that led to the failure of the industry were: opposition from economically threatened groups through public policies; poor organization of the private sector; and the lack of support networks among actors.

Resistance from Economically Threatened Groups

Economic interests are very powerful and very important for our understanding of the policy obstructions in the development of EV technology in Nepal. The economic interests of conventional transportation entrepreneurs have been particularly significant in hindering the growth of the EV development. These groups saw the EV proliferation as a direct threat to their long-time income source.[124] Like any powerful fossil fuel interest groups, these business groups are organized and have a great influence on the government's policies concerning transportation.[125] On the contrary, the EV investors were new and small in numbers, with no experience in the politics of the transportation industry.[126] Many EV entrepreneurs claimed that their passion for improving air quality motivated their involvement in EV enterprise.[127]

---

[124] Interview: Adam Friedensohn, "Jeevan" Goff, Ashok Pandey, Hridaya Manadhar, and Bimal Aryal,
[125] Aryal, B. 2002; Interview: Adam Friedensohn, Ashok Pandey, Bikash Pandey, Hridaya Mananadhar, and Bimal Aryal.
[126] Interview: Adam Friedensohn, Ashok Pandey, Hridaya Manadhar.
[127] Interview: Ashok Pandey, Hridaya Manadhar, Adam Friedensohn, "Jeevan" Goff and Ramesh Man Singh.

Many air quality and EV advocates cited "corruption" as a driving force in the government's transport policy-making.[128] As one observer candidly stated, "The transport policy of Kathmandu Valley remains heavily influenced by vested interest groups -- police officials, politicians, and bureaucrats. All of them get share from operators of polluting vehicles in one way or another."[129] In fact, what originally started out as a protection to encourage the private sector to invest in public transportation in the early 1980s has developed into a "business nexus"[130] between the importers of the vehicles and the government's Department of Transport Management.[131] Payment of commissions has been reported to be one of the major elements of this nexus.[132] Hence, the nexus has been based on mutual benefits: as another critic has alleged, "the nexus feeds the government, the government[133] makes policies which in turn feeds the nexus."[134] These importer groups include entrepreneurs investing in diesel- and petrol-based public transportation such as three-wheelers, minibuses, buses, trucks, and taxis.[135] They are organized through various associations and their umbrella association is the Nepal Transport Entrepreneurs Association.[136] This business connection has strengthened over time with the increasing investment of millions of dollars in this sector by these entrepreneurs.[137] From 1992 to 2000, they contributed to the growth of public transportation by about 40%.[138] Because of their huge contribution to the public transportation, the government has even included these groups in the decision-making process concerning transportation policy since 1994/1995.[139]

Furthermore, regarding policy obstructions created by the nexus, it becomes important to discuss political conditions of Nepal. One of the key barriers to better policy design has

---

[128] Most of the interviewees from the private sector, NGOs, and International Donor mentioned this as a major cause.
[129] Cited in Baral, A., Parajuli R., and Aryal B. 2000.
[130] As quoted by Ashok Pandey.
[131] Interview with Bimal Aryal, Ashok Pandey, Adam Friedensohn, and Bikash Pandey.
[132] Interviewees preferred to remain anonymous.
[133] Here, the government implies only some self-interested officials.
[134] Remarks by Ashok Pandey.
[135] Aryal, B. 2002 (unpublished).
[136] Interview with Bimal Arayal.
[137] Interview with Bimal Arayal; Aryal, B. 2002 (unpublished).
[138] Department Of Transport Management. 2002.
[139] Interview with Bimal Aryal. Aryal, B. 2002 (unpublished).

been the unstable political system of Nepal. The era of 1992 to 2000 saw many changes in the Nepali political system. The major government changed more than 10 times, with an average of one new government per year.[140] As a result, there were frequent reshufflings of the ministers and ministries' officials. Since the government did not have clear policy directives for clean technology such as electric vehicles, it became an easy task for the vested interest groups to influence a new government, or more precisely, a new minister, who lacked knowledge about the new ministry.[141] The scenario of the ever-changing government also provided loopholes for anti-EV groups. In fact, the decision to allow 500 petrol tempos (January 1999) occurred during the overnight hiatus between the exit of the one government and the effective beginning of the next.[142]

The government also had a motive to support the opposing interests since the expansion of EV meant losing income from the import tax.[143] The import of vehicles generated millions of dollars of revenue for the government every year.[144] There were two main forces that created resistance in the EV development process through different ways.

The "Diesel Mafia": Known as the "diesel mafia" to EV advocates, the diesel interest group has been a major resisting force.[145] Apart from owning the very polluting Vikram tempos, this group is also alleged to control a major portion of public transportation, including taxis, buses, and other gasoline-powered three-wheelers.[146] Phase I experienced little of their resistance because EVs were only being experimented with and would likely pose little threat to their interests. In late Phase II, EVs started to grow and the environmental NGO advocacy adopted a more concrete goal – i.e. the banning of all Vikrams. This seems to have endangered the economic interests of the diesel mafia, intensifying their influence on a number of government decisions in Phase III. One such influence was seen in the banning decision, which also provided a provision for the

---

[140] General Knowledge.
[141] Interview with Bimal Aryal, Bhushan Tuladhar, Bhoj Raj Ayer, and some MoPE officials.
[142] Personal experience. I was working at the Ministry of Environment and Population then.
[143] Interview with Ashok Pandey.
[144] As claimed by Ashok Pandey.
[145] Since many vehicles in the public transportation used to run on diesel fuel, this group is generally called the "diesel mafia." Interview: Adam Friedensohn , Bimal Aryal, Jeevan Goff, and Ashok Pandey.
[146] Interview with Bimal Aryal; Aryal. 2002; Baral et al. 2000.

Vikram owners to be allowed to import microbuses (both diesel and LPG) in September 1999.[147] While the ban appeared to have favored the Safa tempo (as the decisions saw an immediate expansion of the Safa tempo to 600), the latter part remained a pitfall. In actual fact, it was a gap and substitution policy, seemingly intended for the "diesel groups."[148] Also, EV groups claimed that the diesel mafia had a law on their side because the police owned the majority of Vikram tempos and gave the Safa tempos a very hard time.[149] For the diesel interest group, the EV industry emerged as a rival in Phase III – one EV equaled to one less diesel vehicle.[150] This perception seems to have been compounded by the limited carrying capacity of the roads of the Kathmandu Valley. Hence, some critics believed, it was not a question of "both/and" for this group, but "diesel" versus "EV."[151]

Liquid Petroleum Gas (LPG) group: Another interest group that was proactive in Phase III was the LPG vehicle importer group. This group can be considered more as an opportunist that has taken advantage of the government's fragile decision-making system, as well as its lack of competent manpower. Despite early warning by the Global Resources Institute back in 1995 about the potential disadvantage of LPG-powered tuk tuks, this group managed to convince the government to view these vehicles as ultra-low-emitting vehicles and be subsidized as such, while at the same time enjoying cross-subsidy of LPG fuel (originally intended for the purpose of cooking).[152] The creation of this new group amid the beginning of the EV industry only added to the opposition force of the diesel mafia.[153]

Inconsistent policies

Because of this interplay of opposing forces and the government, EV development encountered a trend of policy reversal. As we saw in the previous chapter, the government's decisions sometimes favored the diesel interests and sometimes appeased

---

[147] Aryal et al. 2000; Interview with Bimal Aryal.
[148] Interview: Ashok Pandey, Hridaya Manandhar, Adam Friedensohn, Bimal Aryal and Bikash Pandey.
[149] Lieberman, Joseph. 2001. http://www.eugeneweekly.com/03_22_01/news.html#news3
[150] Interview with Adam Friedensohn and "Jeevan" Goff.
[151] Interview with Adam Friedensohn.
[152] Interview: Bimal Aryal and Bikash Pandey; Martin Chautari. July 2000.
[153] Interview with Bikash Pandey; General observation.

the EV advocates. When the EV lobbying force became influential, the latter would occur.[154] The decisions to ban Vikrams and to revoke a number of provisions (as shown in Figure 2) are some examples. In the year 2000, the government generally reversed their policies toward EVs for the benefit of opposing forces. It granted both tuk tuks and microbuses the same preferential treatment as zero emission electric vehicles. As indicated earlier, this decision saw the arrival of 600 microbuses, half of them diesel and half LPG-powered, and 600 LPG tuk tuks in the same market as the 600 EVs. This created an "artificial" market situation in which *zero-polluting vehicles had to compete with polluting but subsidized vehicles.*[155] Thus, the EV market failed. Two reasons primarily accounted for these failures: cost disadvantage and ultimate "market saturation."

Cost Disadvantage: The subsidized Safa tempos became more expensive to run and ride than their competitors, the microbuses and LPG three-wheelers, which, too, were subsidized. The running costs of the EV became the highest at US$ 0.080/km (NPR 5.96/km), as compared with the LPG microbus at US$ 0.045/km (NPR 3.37/km), LPG three-wheeler at US$ 0.032/km (NPR 2.45/km) and diesel microbus at US$ 0.044/km (NPR 3.29/km).[156] Similarly, the passenger fare for the Safa became the highest over comparable routes.[157] The removal of VAT exemption on components in mid-2000 only added to the operational costs of the industry because of costly maintenance and repair.

Because of the expensive fares, the Safa tempos also started losing their customers to their competitors.[158] LPG tuk tuks also had the privilege to run as " pollution-free vehicles."[159] This misleading status was easier to maintain because of the lack of visible tailpipe emissions (suspended particulate matter). LPG is a clean-burning fuel with a

---

[154] Interview with Bimal Aryal and Bhushan Tuladhar.
[155] Interview with Bimal Aryal and Bikash Pandey.
[156] Cited in Devtec Nepal P. Ltd. 2001; Palanchowki, R. 2002.
[157] Cited in Devtec Nepal P. Ltd. 2001; Palanchowki, R. 2002; Interview with 14 commuters and Bimal Aryal.
[158] Interview; Megh Nath Rijal, Dick Bhola Rai, Ramesh Man Sing, Bimal Aryal, and 3 drivers.
[159] Field Visit: there is a slogan "Pollution Free Vehicle" written on the both sides of LPG vehicles; Ministry of Finance, 1999;

particulate emission factor of 0.24 g/km, or even less.[160] Like LPG vehicles, microbuses also pollute relatively less than the Vikram tempo (even a diesel microbus has a much cleaner engine).[161] To the commuters, all the vehicles looked similar in terms of tail-pipe emissions – no visible "black smoke."[162] The commuters seemed to be largely indifferent toward the pollution benefits of these three types of vehicles.[163]

"Market Saturation": The ban of 600 Vikram tempos created a market gap, but with the arrival of 1800 additional vehicles, including Safa, tuk tuks, and microbuses,[164] the gap became oversupplied.[165] When the first 600 Safa tempos came in 1999/2000, there was an unmet demand and these Safa tempos soon filled this demand. After the penetration of tuk tuks and microbuses, there were too many vehicles on the routes and not enough passengers, bringing "market saturation" for both the Safa tempo and its lower-priced competitors.

This situation provided an opportunity for concerned interest groups to target the Safa tempos. EV advocates argued that the decision to ban the new registration of three-wheelers was meant to completely stifle the EV's survival in Kathmandu and to make room for fossil-fueled vehicles.[166] They also believed that the supposed "market saturation" was a distortion caused by the "same preferential treatment" policy for both polluting and non-polluting vehicles.[167] They cited the public transportation system of Kathmandu itself as another reason for the market saturation.[168] The public transportation system is not well planned because transportation network is inadequately dispersed.[169] There are many routes which have not been explored and are plausibly claimed to be greatly underserved. For example, many residential areas away from the main roads are

---

[160] Sharma, Usha. 2001
[161] Ministry of Population and Environment. 2000.
[162] General observation and interview with some commuters.
[163] Based on interview with Bimal Aryal and 15 commuters.
[164] Microbus has double the capacity than a tuk tuk and the Safa tempo.
[165] Interview with Bikash Pandey, Ashok Pandey, P.S. Joshi, Naresh Pradhan, Adam Friedensohn, Sushil Agrawal, Bimal Aryal, Hridaya Manandhar, and P.P. Pokharel.
[166] Interview: Bimal Aryal, Bhushan Tuladhar, Bikash Pandey, all EV actors, and some Ministry of Population and Environment Officials who did not want to be named.
[167] Interview: Bikash Pandey, Bimal Aryal, Ashok Pandey, and others.
[168] Observation by Bikash Pandey, P.S. Joshi, and Narendra Pradhan.
[169] Klaus, B. & Pradhan, N. 2001; Observation by Bikash Pandey, P.S. Joshi

not connected to public transportation and people from these areas have to walk all the way to the trunk roads to catch public vehicles. Nobody has yet researched these routes. Once a new route is open, its market becomes open to everyone. Because of its nature as a public good, there is a lack of willingness on the part of private entrepreneurs to explore new routes: the upfront cost of opening a new route is not appealing to anybody because there are too many free-riding competitors as soon as the route is open.[170] Hence, all types of entrepreneurs want to serve the existing routes rather than open up new routes, even though the new routes have potential.

Entrepreneurs see the provision of route exclusivity for zero emissions vehicles as essential to address this issue. However, the Department of Transport and Management (DOTM) is unlikely to support this type of privilege if the business nexus plays its usual strong role. DOTM itself has indicated its inability to treat EV vehicles exclusively because they consider all vehicles the same, as long as these vehicles meet the Mass Vehicular Standards.[171] But unfortunately, these standards have hardly been enforced. Another agency that can enact such a measure is Kathmandu Metropolitan City, if such routes lie within the boundary of KMC. But KMC maintains that its roles have been largely constrained by minimal authority endowed by the central government.[172] Thus we see that the supposed "market saturation" is merely an artifact of deficient public policy.

Politicizing battery pollution

The battery pollution issues that were raised were more political than technical. The pollution debate has become a rallying point for the interests opposing the Safa tempo. The same media that worked for lobbying and advocacy for EVs also succeeded in creating negative perceptions about EVs.

Lead in EV batteries is hazardous and, if not managed properly, can have a detrimental impact on the environment and public health.[173] However, the lead and acid of EV

---

[170] Interview with Bikash Pandey.
[171] Interview with Sushila Agrawal.
[172] Interview with P.S. Joshi.
[173] Aryal et al . 2000.

batteries can be contained and recycled.[174] Of all battery lead, generally 96% is recyclable.[175] In Nepal, EV battery waste contributes to only 7% as opposed to 85% of fossil-fuel battery wastes.[176] Hence, Adam Friedensohn[177] argued that these figures are not comparable and that targeting only EVs for battery pollution was very illogical. However, the opposing interest groups, including LPG groups and diesel groups, did not see it this way, and their campaign against this issue (primarily through newspapers) succeeded in tarnishing the otherwise clean image of the Safa tempo.[178] People questioned the credibility of the EV as a clean technology. Clean Energy Nepal, an environmental NGO, even organized a public hearing that took place in March 2001 to examine the allegations. EV stakeholders claimed they collected the expired batteries and sold them to scrap dealers at NPR 500 –700 per set. These scrap dealers would take them to neighboring India for recycling. Also, some expired batteries were used for other low-current applications such as for solar panels, computers, and lighting.[179]

However, counter-arguing against the batteries of other vehicles or even claiming EV batteries do not pollute could be neither a convincing nor legitimate argument. Nepal and India are both party to the Basel Convention and both have a commitment not to allow the transfer of hazardous material to a second country without its permission.[180] This may make the present transfer of EV batteries to India an illegal act.[181] In the long run, however, government-to-government agreement seems necessary for this trans-boundary transfer of battery wastes from both EVs and other vehicles, given the economic logic and the feasibility of reliable containment of the battery components. In fact, some government officials acknowledge that the allegation of EV battery pollution was misleading, but were unable to comment because of the government's obligation to the Convention.[182]

---

[174] Interview: Adam Friedensohn; General Knowledge.
[175] Battery Council International: http://www.batterycouncil.org/recycling.html
[176] Interview: Adam Friedensohn; Aryal, et al. 2001.
[177] Founder member of Electric Vehicle Company and currently a Chairman of Lotus Energy Pvt. Ltd.
[178] Aryal, et al. 2001.
[179] Eisenring, Markus. 2000.
[180] MoPE. 2000.
[181] Hansen, E and Shrestha, 2001.
[182] Interview with MOPE officials.

In late 2000, DANIDA helped explore a number of solutions, including setting up a battery recycling plant. It found that coming up with an economically viable option is still a ways off because of cost and uncertain demand for the recycled batteries.[183] Therefore, the EV will continue to be a scapegoat for its use of a sizable number of lead-acid batteries until a satisfactory option for battery recycling is found. The debate over EV battery pollution will continue to provide a bargaining chip for the vested interest groups seeking a major say in the decision-making process.

Failed Management

The transition of the EV industry's development from Phase I to Phase II (refer to Chronology of Development) created a discontinuity in the way the Safa tempos had been managed. Given the special character of the industry, Global Resources Institute envisioned a management structure in which a company would build, service, and operate its own fleet of at least 25 vehicles. While recommending such a plan to Nepali investors, GRI failed to take into account the business culture and the interests of the business community in the Kathmandu Valley. Hence, the management course that the private sector followed in Phase II turned out very differently from the one suggested.

There are a number of reasons why the EV industry followed a different course.[184] First, the proposed business model was unfamiliar to investors and businesses in Nepal. The business culture had traditionally been one of trading and individual-owner enterprises, as opposed to forming an integrated business organization. This inclination was even more prominent in the transportation sector, in which many people individually own one or a few vehicles and operate them on a daily income basis, either personally or by renting them out to drivers. Because of this culture, many investors were uncomfortable with managing a large number of drivers because the drivers were not considered trustworthy. In Kathmandu, many vehicle owners suspect drivers of withholding some income at the end of the day.[185] Also, the profit interest of the business community is generally geared

---

[183] Interview with Adam Friedensohn and Bikash Pandey.
[184] Interview with Peter Moulton.
[185] General Observation.

toward quick returns on investment, which makes the trading culture all the more persistent. As a result, none of the companies followed a GRI-inspired plan based on the economics of vertical integration.

"Self-interested" EV groups

Although at the outset, Nepal Electric Vehicle Industry (NEVI) adopted the "build, service and own" modality, the industry in general began to develop as a manufacturing and marketing industry, selling vehicles to individual operators. While some owners operated their own vehicles, most of them leased out vehicles to drivers and collected money at the end of the day. Meanwhile, manufacturing industries decentralized the charging services by encouraging investors to build separate charging stations. Over the course of a few years, the industry saw the growth of the decentralized EV industry with a number of separate EV-related functions: manufacturers, charging stations, operators, drivers, battery dealers, and spare parts distributors, as well as maintenance and repair workshops. Their interests were often self-centered and failed to serve the general interest of the EV industry. At the heart of this unawareness of the optimal path for mutual benefit was a desire to reap quick returns on investment, which could be characterized as the following:

Manufacturers: These manufacturers wanted to achieve their quick return on investment by selling vehicles to individual owner-entrepreneurs at a high-markup selling price. The actual cost of the vehicle manufacturing was estimated to be US$4,800 (NPR 330,000) while the selling price was US$5,760 (NPR 395,000)[186], allowing a profit of 20% over the cost.[187] Although this profit was an official figure, operator-entrepreneurs believed the true manufacturing cost was much less.[188] The profit strategy of a few manufacturers was to sell as many vehicles as possible at a higher price while there was still demand for them.[189]

---

[186] Moulten, P. and Cohen, M. 1998; Eisenring, 200; Based on the exchange rate of January 2000.
[187] Interview with Megh Nath Rijal, Dick Bhola Rai, Hridaya Manandhar, Bimal Aryal and Peter Moulton.
[188] Interview: Megh Nath Rijal, Dick Bhola Rai, Hridaya Manandhar.
[189] Interview: Ashok Pandey and P.P Pokharel.

In a bid to sell as many vehicles as possible, the manufacturers did not adequately transfer their knowledge concerning the long-term costs of battery replacement, and the risks of improper handling and maintenance of EV batteries by unskilled personnel.[190] As a result, buyers overestimated the future profit at the time of buying.[191] The manufacturers provided only 6-months warranty because of the risks related to irresponsible driving behavior.[192] Nor did they make available a user's manual for EV operation and maintenance.[193] The drivers' behavior is largely responsible for poor performance of such vehicles.[194] Naturally, the manufacturers wanted to avoid being accountable for faults that they did not commit.

Operator-Entrepreneurs: Operator-entrepreneurs, constituting over 76% of the overall numbers, wanted to make daily income by leasing Safa tempos to drivers in return for a daily payment. They provided a monthly salary to the drivers for their driving service. The rest of the operator-entrepreneurs were the ones who either owned charging stations or drove their own vehicles.[195] To operate the vehicles, entrepreneurs had to disburse the revenue they received to a number of companies or individuals: to obtain vehicles from the manufacturers; to purchase batteries from the battery dealers; to have batteries charged at charging stations; to obtain spare parts in the case of breakdowns; to get service and maintenance; and to have vehicles operated by drivers. Each entrepreneur bore these overhead and operating expenses to operate their very few vehicles, which did not generate enough revenue to spread over these expenses.[196] The investment gave them ownership of the vehicle without realization of the many expenses they had to bear, and without the skills and knowledge to manage the Safa tempo operation. Yet because of their ownership, they have the principal interest in the well-being of their vehicles and the batteries.

---

[190] Devtec Nepal P. 2001; Eisenring, M. 2000.
[191] Devtec Nepal P. Ltd. 2001; Interview with Megh Nath Rijal, Ramesh Man Singh, and Bimal Aryal.
[192] Interview with Adam Friedensohn, Ashok Pandey, P.P Pokharel.
[193] Devtec Nepal P. Ltd. 2001.
[194] Kemp, R., Schot, J., and Hoogma, R. 1994.
[195] Devtec Nepal P. Ltd. 2001.
[196] Interview: Peter Moulton, D.B. Limbu, and Megh Nath Rijal.

Charging Stations: The charging stations would charge as many vehicles as possible per day to maximize their profit, even at the expense of service quality.[197] Entrepreneurs alleged that the charging station owners set too high a margin for covering expenses such as overhead, labor, and maintenance; they charged entrepreneurs US$ 0.13/unit of electricity (NPR 9), out of which they paid US$ 0.06/unit (NPR 4.30) to Nepal Electricity Authority.[198] They did not own batteries or vehicles (there are some exceptions) and thus had little incentive for taking extra care in charging the batteries for the benefit of entrepreneurs. Nor did they take any initiative to train their personnel adequately because producing skilled laborers meant extra cost which they did not want to bear.[199]

Drivers: The drivers, too, maximized their income, beyond the monthly salary that they received from the owners, because they had control over how they would operate the vehicle during the day. They increased their income by making an extra loop and overloading the vehicle beyond the capacity of the battery because their operator-entrepreneur employers did not monitor their driving behavior.[200] They were oblivious to the implications of their money-making strategy for the performance of the vehicles and batteries. They did not own vehicles, and the owners would pay for the cost of breakdowns.

Battery Dealers: The battery dealers wanted to make a profit by selling EV batteries at a high mark-up price.[201] Since the EV industry had chosen to use only one type of battery, these dealers monopolized the battery supply and sold at a high price.[202] Many EV entrepreneurs claimed that the two sets of Trojan-125 batteries would not cost more than US$1200, as opposed to the US$ 1700 that they had to pay the dealers.[203] The presence of

---

[197] Complaints of operator-entrepreneurs cited in Devtec Nepal P. Ltd. 2001.
[198] Devtec Nepal P. Ltd. 2001.
[199] Complaints of operator-entrepreneurs as cited in Devtec Nepal P. Ltd (2001).
[200] Complaints of operator-entrepreneurs as cited in Devtec Nepal P. Ltd (2001); Interview with Bikash Pandey, Hridaya Manandhar, Bimal Aryal, Megh Nath Rijal, Ramesh Man Sigh, Ashok Pandey and others.
[201] Interview with Ashok Pandey, Ramesh Man Singh, Bimal Aryal, and Hridaya Manandhar; Martin Chautari. July 2001.
[202] Interview with Bikash Pandey, Hridaya Manandhar, Bimal Aryal, Megh Nath Rijal, Ramesh Man Singh, and Ashok Pandey.
[203] 2 sets of 12 pieces of 6-volt battery are needed at one time. The Trojan company's selling price to an individual buyer is $1,320. The wholesale price is believed to be even less.

a single exclusive dealer later made the battery supply situation even worse when the entrepreneurs also faced battery shortages.

Other parties: Because EVs made up only a small portion of their business, the EV *spare parts dealers* did not consider it very lucrative to buy expensive genuine parts from the original equipment manufacturers to supply the operators. Similarly, the *maintenance and repair workshops* did not have the incentive to develop special manpower for EVs since EVs constituted only a small portion of their business.

Each group's profit-oriented self-interest was not problematic in itself, but turned out so because the groups failed to adjust their individual short-term interests to serve the general interest of the EV industry. In the EV industry, the daily range and life span of EV and the soundness of vehicles were the single most factor affecting the economics of their operation.[204] But none of the interests, apart from that of operator-entrepreneurs, was concerned with the optimum performance of vehicles and batteries.

Since their interests did not harmonize, the EV actors emerged with three distinct functions: those who had control of a vehicle, those who had ownership, and those who had knowledge. There was a misalignment of these functions, causing inefficiencies in the EV management. Economically, the Liability Rules theory predicts that such inefficiencies will result from the misallocation of ownership and actions.[205] Hence, the actors who did not have ownership of vehicles acted irresponsibly because the cost of this behavior was external to them. The primary EV groups -- manufacturers, charging station owners, operators, and drivers -- all serve as good examples.

The manufacturers had the knowledge, but had the least involvement in the use of this knowledge once vehicles were sold. The operator-entrepreneurs had the ownership, but were ill-equipped to maintain their vehicles and batteries. They had little technical knowledge and no control over their vehicles once they handed the keys to drivers for daily operation. Plus, they did not monitor drivers or any abuse of vehicles. Drivers and

---

[204] As per the claim of all interviewees.
[205] Titenberg, T. 2000. Pp- 80.

charging station personnel had the most control over the health of the vehicles and batteries. However, they did not have any incentives to exercise that control carefully. Hence, the drivers would drive beyond the safe discharge level of batteries and the charging station owners would not soundly charge the batteries. The costs of the technical failure of vehicles and batteries were external to them.

Those who had knowledge or control over the vehicles were not liable for their actions. The outcome was the poor performance of vehicles and batteries: the batteries would expire prematurely and vehicles would often break down.[206] The life span of most batteries was only 12-13 months as opposed to its 22 months of warranted life span.[207] Any failures in battery and vehicle performance caused by the charging and exchange facilities or by the drivers were paid for directly by owner-entrepreneurs, putting them at the highest disadvantage. Hence, the entrepreneurs did not realize their expected return on investment and were unable to pay off their loans, souring their confidence in the business. Agricultural Development Bank shows the highest figure of the overdue loan amount to be 10% by Safa tempo, followed by LPG microbuses at 3.3% and tuk tuks at 2.4%.[208] Of the tempos financed by DANIDA for repayment within 4 years, only about 24% of the borrowers had paid half the amount within 2 years of the loan disbursement.[209]

The poor performance of vehicles and batteries caused further loss for entrepreneurs.[210] They faced extra expenses for vehicle repair and maintenance. Even then, their vehicles would not get proper maintenance because of the lack of quality parts and skilled mechanics. Also, they encountered the expiration of the batteries earlier than they had expected and found themselves without enough savings to buy a new set. Because the sole battery dealer did not supply these batteries in time and at a reasonable cost, their vehicles were idled, adding to losses for the operator-entrepreneurs. Here, accountability remained only with entrepreneurs, who did not know EV well.

---

[206] Eisenring, M. 2000.
[207] Eisenring, M. 2000.
[208] Based on the figures of Agriculture Development Bank.
[209] Ministry of Population and Environment. 2002.
[210] Interview with Bikash Pandey, Hridaya Manandhar, Bimal Aryal, Megh Nath Rijal, Ramesh Man Singh, P.P. Pokhrel, and Ashok Pandey.

Although the Safa tempos were proliferating in numbers, the industry was facing a crisis internally because of the deficiency of effective management. The crisis affected operator-entrepreneurs first, followed by manufacturers and the charging station owners.[211] In the decentralized market structure, the owner-entrepreneurs have become the central actor of the EV industry, whose demand for vehicles has kept the EV industry running.

In essence, there was the misalignment of knowledge, control, and liability in the functions of EV groups. This allowed the disparate self-interested groups to maximize their short-run benefit at the expense of one another, causing inefficiencies in the EV management. Hence, the EV industry failed to maintain the technological viability of the EVs.

Lack of Skilled Human Resources

A key element that the private sector overlooked during the EV development process was the need to build a skilled labor force within the industry: the qualitative aspect of the EV industry.[212] A number of factors accounted for this shortcoming.

As we discussed, the groups had disparate self-interests with control over different functions of the industry. The mismatch of ownership, control, and knowledge in these functions provided little incentive to focus on developing manpower in the industry. For example, the charging stations did not want to hire or train better manpower by expending extra investment because this cost would reduce their profits. Similarly, the entrepreneurs did not prioritize hiring skilled drivers because they were oblivious to the possible consequences. As a result, the unskilled drivers and personnel handling EVs caused many technical failures. Eisenring says, "Theoretically the charging profile follows constant current-voltage-current phase (IUI) charging profile. But what was

[211] Interview: Bikash Pandey, Ashok Pandey, Bimal Aryal, and Adam Friedensohn.
[212] Observed from interviews.

measured in various charging stations is everything but ideal."[213] For example, on average, only 33% of the labor engaged in charging stations was skilled.[214]

The sudden proliferation of EV fell short of making the industry healthy. The demand for new vehicles suddenly became so great that manufacturers produced Safa tempos in large numbers and sold to entrepreneurs who knew little about EV technology.[215] For the long-run success of the EV market, Gärling and Thøgersen caution that EVs should not be "over-marketed" by selling to people who do not have the capacity to maintain an EV and will inevitably get into trouble with it in the future.[216] The manufacturers, driven by the urgency of the market and also by the desire for short-term profit, failed to examine the interests and capacity of the customers to manage the Safa tempos. In an attempt to attract entrepreneurs, they understated the caveats of the EV, such as the high risk of improper handling of batteries. A DANIDA study (2001) found that a large number of operator-entrepreneurs blamed manufacturers for their business failure because they were not informed about the likely expenses and problems of vehicle management.[217]

On the other hand, many individual operators, in haste to take advantage of the favorable market, and without doing much research, began to lease their vehicles to drivers who were either not skilled or previously involved with the Vikram tempo. These drivers drove EVs with the mindset of driving the Vikram tempo. They would overload and overdrive the vehicles to make extra daily income that they could pocket. Many drivers did not develop a sense of driving EVs. Their behavior did not adapt to the special needs of the Safa tempo (it has a limitation in range and speed).

Nor was there any attempt to set driving codes from the enforcement agency. Even now, the enforcement agency, Kathmandu Valley Traffic Police (KVTP), uses the same curriculum for issuing EV driving licenses as for other fossil-fuel-operated three-

---

[213] Markus Eisenring is an Electric Vehicle Expert who undertook investigated the problems of the EV industry; Eisenring, M. 2000.
[214] Devtec Nepal P. Ltd. 2001.
[215] Interview with Bimal Aryal and Bikash Pandey; Devtec Nepal P. Ltd. 2001.
[216] Gärling, Anita and Thøgersen. 2001.
[217] Devtec Nepal P. Ltd. 2001.

wheelers.[218] For example, many, if not all, of the questions that are asked in the driving exams are concerned with the running of either petrol or diesel vehicles. Thus, it never became a requirement for the drivers to learn new skills for driving a Safa tempo.

Because of the urgency of the ban and the consequent demand for more vehicles, everything seemed at first to be working for EVs, even without acquiring skilled manpower. Hence, the EV group did not prioritize "building skilled manpower" in the industry. Eisenring reported that many owners, the drivers, and the charging station owners had not even the fundamental knowledge of batteries and vehicles.[219] The urgency left little time to reflect and learn about the technology. This presence of unskilled manpower began taking its toll on the industry as it faced poor performance of batteries, frequent breakdown of vehicles, and subsequent loss of income.

Lack of Support Networks

Support networks are crucial to overcoming various obstacles that technological innovations face.[220] Although various EV groups, environmental NGOs, and donor organizations emerged as supporting actors in different capacities, they failed to form effective networks among and within themselves. There were a number of constraints on networking. Some EV players had narrow interests which did not overlap. Some did not have resources adequate or conducive to forming networks. This section will analyze how the deficiencies of support networks created inefficiencies in the EV development process.

Failure to solve problems

In Phase I, Global Resources Institute networked with the potential investors and the government and created a supportive environment for the commercial launching of the Safa tempo. The urgency to find alternatives to fossil-fuel vehicles to alleviate the deteriorating air quality facilitated GRI's networking. In addition, GRI's NGO status and the support of the U.S. Embassy lent credibility to its networking efforts with the

[218] Devtec Nepal P. Ltd. 2001.
[219] Eisenring, 2000; Devtec Nepal P. Ltd. 2001.
[220] Kemp et al. (1998); Kemp et al. (1994); Laws et al. (2001); Esenring (2000)

government and the private sector, and thus achieved a breakthrough in the policy for supporting electric vehicles. This network played a role in creating a niche in the market through subsidy and "prioritized industry" status.

However, this network was lost during the transition from Phase I to Phase II. New actors emerged with new roles. The private sectors formed their own networks, but were divided because of their differing interests and the way they organized themselves. Although the groups networked through associations, none of the associations networked with each other.[221] There were divisions within each association.[222] For example, there were three types of entrepreneurs even within Clean Locomotive Entrepreneurs Association Nepal (CLEAN): owners who drove their own vehicles, owners who leased out vehicles, and owners who owned charging stations. While the first two groups are in the minority but have been fairly well off, the last one, which constitutes a majority (about 76%, as was mentioned previously), has been at a disadvantage.[223]

As was discussed, each EV group confined itself to very narrow responsibilities. For example, there was no effective relationship among groups. Although owners interacted with drivers, the interaction was limited to the end-of-the-day transaction. Apart from basic business dealing such as charging, driving, and selling, problem-centered networks were absent. The problem varied from the vehicle breaking down to batteries not giving adequate range and expiring too quickly.[224] For example, when the battery started giving short life, the operators could not know whether it was the poor charging or the poor driving that caused it. As a result, the industry was unable to solve problems in time. Everyone saw problems in the EV batteries when they started giving low ranges, but did not understand how the problem was created.[225] When the entrepreneurs began to realize their loss of income and the possible fault in the performance of batteries, they had no way of improving the situation because of their own lack of technical knowledge.

---

[221] Interview with Bhushan Tuladhar, Bimal Aryal; Aryal et al. 2000.
[222] Interview with Ashok Pandey and Hridaya Manandhar.
[223] Interviews with Ashok Pandey, Bikash Pandey, Hridaya Manadhar, and Bimal Aryal; Devtec Nepal P. Ltd. 2001.
[224] Interview with Ashok Pandey, Bikash Pandey, Rajendra Adhikari, Hridaya Manadhar, and Bimal Aryal; Devtec Nepal P. Ltd. 2001.
[225] Interview with Bikash Pandey, Bimal Aryal, and Rajendra Adhikari.

It was only after the accusations and counter-accusations among groups that they admitted the problems resulted from poor handling of the batteries.[226] While the charging stations considered the problem to be the driver's overloading and making extra loops out of vehicles, the drivers blamed the charging stations for not using proper techniques. These problems did not receive proper attention because the pertinent parties could not coordinate their grievances as a group. Only the individual operators were likely to seek solutions but had few resources of their own.

Battery shortage is another problem that is largely due to the lack of a communication network between suppliers and vehicle owners. Vehicle owners did not order batteries on time and suppliers did not know when the batteries would run out and create new battery demand.[227] According to Lotus Energy (a sole supplier), once they received orders, it would take three months for them to import and deliver Trojan lead-acid batteries to suppliers. Their experience showed that EV owners placed orders only after the batteries had expired.

Although a central association, Electric Vehicle Association Nepal (EVAN), was later formed as a support network at the end of 2000, divided interests have posed a major barrier to its effectiveness.[228] EVAN admits that its network is incomplete.[229] It involves only three parties: CLEAN, EVMAN, and NEVCA. Apart from informal networking with Martin Chautari, it has not included other major stakeholders. At times, the network with Martin Chautari helped bring management assistance in the forms of training for drivers and information about the technology.

Inability to exert political clout

Although the environmental NGO efforts built a lobbying force against the EV opposition, the efforts lacked adequate networking with potential supporters. These

---

[226] Interview with Bikash Pandey, Bimal Aryal, and Rajendra Adhikari.
[227] Interview with Adam Friedensohn, "Jeevan' Goff, and Hridaya Manadhar. .
[228] Interview: Bhushan Tuladhar, Bimal Aryal, Bikash Pandey, Ashok Pandey, and many others.
[229] Interview with Ashok Pandey, Chairman, EVAN.

NGOs admit their own lack of networking among themselves.[230] Although they came together during the time of crisis when the government made the EV regressive decisions, they failed to coordinate building continuous pressure on the government.[231] Networking for NGOs has its own constraints of human and other resources. Because of these constraints, the NGO players sometimes took wrong approaches, while at other times making inadequate efforts.

The case in point is inefficiencies in the efforts of the Electric Vehicle Promotion project of Martin Chautari (MC). Martin Chautari did network with EV groups, but this was far from sufficient. With only three personnel and limited funding from Renewable Energy Support Office of Winrock International (INGO), Martin Chautari did not have enough resources to play a bigger role. This deficiency often became evident when things did not go right. Oftentimes, MC did not undertake sufficient research prior to advocacy and lobbying. A case of LPG vehicle lobbying by MC was one example. To build a strong coalition against the diesel mafia, it allied with tuk tuk supporters, thereby advocating for LPG during Phase II and the beginning of Phase III. Although the strategy succeeded in pushing the government to ban the Vikrams, MC later realized that the LPG vehicles were not as "less polluting" as they had thought them to be.[232] Even after this realization, they were unable to immediately direct their lobbying against tuk tuk because of insufficient resources. This proved very costly for EV since LPG vehicles had established their presence in half of the potential market of EV.[233]

The NGO-government relationship was generally antagonistic. As discussed previously, the government bodies related to transport were inclined toward the business nexus. To counteract this nexus, the most common approach that the NGOs followed was lobbying. Their interactions with the government were mostly limited to public forums, letter campaigns, and broadcast media.[234] The government would make closed-door decisions favoring the interests of the "diesel" groups, leaving NGOs with no other option except

---

[230] Interview: Bhushan Tuladhar and Bimal Aryal.
[231] Interview: Bhushan Tuladhar and Bimal Aryal.
[232] Interview with Bimal Aryal.
[233] Interview with Bimal Aryal and Bikash Pandey.
[234] Interview Bimal Aryal and Sherjung Karki.

lobbying.[235] While lobbying seemed the most effective weapon for the NGOs to use to oppose the closed-door decisions, that approach alienated them from the government decision-making process.[236]

There were reasons why Martin Chautari could not network effectively with the government.[237] It had a good relationship with the media. It used this partnership to pressure the government. This proximity to media intimidated the government, and prevented an effective interaction between them. Similarly, MC could not establish a network with DANIDA because they did not want to be donor-driven.

As was discussed, the anti-EV forces exerted strong political influence on the government's decision-making. Lobbying alone was not adequate to overcome it. NGOs needed alliances with the government to bring about positive changes. It took 8 years of NGO lobbying efforts to achieve the ban on the Vikram tempo in September 2000. Even then, the decision did not turn out to be a total success because the government permitted the Vikram owners to import subsidized microbuses.

---

[235] Interview with Bimal Aryal
[236] Interview with Bimal Aryal.
[237] Interview with Bimal Aryal

Part III: Lessons Learned

From our discussion in the preceding chapter, there are a number of lessons to learn. Insights can be gained from EV's inception to its first major decline. As was mentioned, the analysis is limited to three-wheeled electric vehicles through the year 2000. There have been a number of ongoing initiatives to revive the EV industry, as outlined in Part 1. The 1993-2000 phase may signal the end of EV three-wheelers, but the beginning for many other promising initiatives such as the electro bus. Also, I expect these lessons to act as a window to reflect on past shortcomings and to develop many new initiatives to advance EV technology.

Build a Coalition of Supporting Actors to Neutralize Opposition

Opposition from fossil-fuel groups can be detrimental to the development of any alternative fuel vehicle such as EV. In Nepal, these groups exerted strong influence on the government (especially the Department of Transport and Management). Having dominated the transportation market for decades, the groups are well organized.[238] Aided by the business nexus, their roots have grown very deep in non-transparent governmental policy-making. The nexus offered the groups an easy means to influence public policies. Their influence achieved preferential treatment for polluting vehicles.

To overcome the opposition to EV, EV advocates need to build a supportive coalition amongst them. Since opposition to EV was effected through public policies, the coalition should focus on creating both external and internal pressure on the government.

One of the main functions of this supporting coalition should be to build pressure against the opposition's influence. Environmental NGOs are effective lobbyists[239], and as such should take the lead in forming this coalition. The present research shows that many environmental NGOs aided the private EV groups on different fronts. They fought with

---

[238] Aryal, B. 2001. Interview with Bimal Aryal;
[239] Sagar, A.D. 2000.

the government for various EV-supportive polices. If it were not for NGOs' lobbying and advocacy (first GRI's initiative and later the works of local environmental NGOs), the subsidies for the Safa tempos and Vikram banning might not have taken place. In fact, to counter the powerful resistance of the fossil-fuel transportation regime, the EV proponents should adopt an NGO front-ended private sector effort for building a NGO constituency behind EV technology.

For an environmental NGO to take the lead, it should first network with other like-minded NGOs. However, NGOs in general have resource constraints in terms of numbers, resources, and coordination.[240] For example, Martin Chautari was wrong to lobby for LPG vehicles, which occurred because there was insufficient staff to investigate the issue more thoroughly. But an even greater problem was inadequate coordination of efforts. We saw there were a number of NGOs working in different areas such as litigation, monitoring, research & development, and lobbying. The NGOs coalition should aim to bring together these divided resources not only in crisis, but regularly, to produce a concrete lobbying force, backed with research, data, and legal tools. For example, as recently as in 2001, Clean Energy Nepal emerged with an initiative for a Coalition for Clean Environment to form networks among environmental NGOs and to promote clean energy. This initiative needs strengthening and expansion to build better-coordinated NGO support for EV.

The opposition is able to operate within government precincts. To counteract this, the coalition should ally with the government and build internal pressure. Furthermore, rather than waiting to lobby until after the regressive decision has been made, the NGOs should seek ways to prevent such decisions by penetrating into the decision-making process. Forming alliances with like-minded government agencies may be a starting point.

How to ally with the government? Not all government agencies are inclined toward the opposition, or rather, the business nexus. The coalition should identify government agencies that have interests in common with it. Examples are the ministries and

[240] Sagar, A.D. 2000.

departments related to health, tourism, environment, and energy. All should have direct interests in promoting EVs. The EV would benefit their respective mandates by enhancing public health, improving tourism, and reducing air pollution. Similarly, the EV should appeal to local governments, such as municipalities. For example, Kathmandu Metropolitan City takes pride in being the first city to introduce EV in South Asia and strives to reverse its dirty image created by air pollution.[241] Semi-governmental agencies like the Nepal Electricity Authority have good reasons to take an interest in EV promotion. The Authority gets annual revenue of approximately US$ 309,902 (NPR 23,300,000)[242] by selling off-peak electricity for EV battery charging.[243] They would likely have foregone this revenue if there had been no EV. Therefore, bringing such agencies together within the coalition will help create direct pressure to neutralize the opposing interest which is so dominant within its own government precincts.

Nepal's experience with EVs also tells us that international donors can be an effective lobbying force. The roles of USAID and DANIDA were important in pressuring the government toward EV-supportive policies at various times. For example, Global Resources Institute praised the U.S. Embassy's support for making the Nepali government introduce EV-supportive pressure.[244] Similarly, the DANIDA's pressure on the government to withdraw the new EV registration was successful for some time. NGOs should bring the concerned international donors into the coalition and build collective lobbying pressure. With international donors' monetary and technological capacity, partnership with them also helps NGOs to address their own resource problems.

In order to consolidate a broad constituency behind EV, the coalition must aspire to organize a governmental and environmental NGO strategy for supporting EV publicly through intensive educational, promotional, and renewable energy-focused activities. To effectively undertake such activities, the coalition should coordinate and take advantage of the interests and funds of international organizations, including both bilateral and multilateral agencies, as well as international non-governmental organizations. For

---

[241] Interview with Rajesh Manandhar, Kathmandu Metropolitan City; The Rising Nepal. February 1996.
[242] The current exchange rate is $US 1 = NPR 77.50.
[243] As indicated in Devtec Nepal P. Ltd. 2001.
[244] Interview with Peter Moulton.

example, the assistance of Winrock International Nepal has been significant in the EV promotion activities through Martin Chautari. A major market strength of EV is their environmental friendliness, being both "zero emissions vehicles" and renewable energy-based (in case of hydro electricity use). EVs flourish greatly in markets where consumers value this clean image.[245] Educating the public about the potential environmental benefits should be a key aspect of promotional and educational activities. At the same time, public education can also play important roles in addressing battery pollution issues, preventing the opposing groups from using this as a tool to weaken the EV market. However, because of the very nature of battery wastes as hazardous and internationally regulated by the Basel Convention, finding a long-term solution requires the coalition to seek national-level efforts to address the issues in the larger framework.

Commitment from the Government to Optimize Policies

A fundamental argument in favor of coalitions was to prevent the opposing forces from shaping public policies to support their own interests. However, what do EV advocates seek from the government while creating the pressure? What policy design should advocates propose? By looking at a number of policy outcomes that the EV development faced, we can learn some policy lessons, too.

Commitment from the government to better policies is a key resource for any alternative vehicles aspiring to thrive amidst the fossil-fuel transportation regime. Competing with highly entrenched fossil-fuel vehicles is a daunting task unless the government is committed to providing policy incentives for change. [246] Hence, government subsidies and incentives are virtually indispensable to building an electric vehicle industry that is cost-competitive compared to fossil-fuel vehicles. [247] Because of the incentives including the tax and VAT exemption, the EV industry *was* able to compete with the Vikram tempo. With these incentives, it enjoyed growth until other polluting, but subsidized, vehicles penetrated the market. If the initial supportive policy had endured, the EV market could have avoided its failure induced by the latter event. This makes the

[245] Garling et al. 2001.
[246] Sperling, Daniel. 1995.
[247] Sperling, Daniel. 1995.

coalition's role all the more important to advocate for government commitments to better policy design that is adequate in length and effective in nature.

Adequate Protection

There should be an adequate length of protection for the EV industry to establish a foothold amid the predominantly fossil-fuel transportation regime. Many EV observers believed that the protection granted for EVs was too short and inadequate.[248] At a glance, the EV industry obviously seems to have enjoyed a number of incentives (from 1995-2000), but none risked jeopardizing the economic interests of diesel groups. Taking a closer look at how government decisions were distributed (refer to Figure 2), government policies started inclining toward reversal from 1999, four years after the first incentive was granted. The government started this trend by first categorizing EV alongside LPG vehicles and microbuses, then finally moving to the registration ban of EV in 2000.

How long should the protection have lasted? The protection should go on at least until the technology manages to establish itself or is highly successful.[249] EVs never got to establish a foothold.[250] The EV industry faced policy obstruction when its numbers were about only 220, which was 3% of the overall public transportation vehicles.[251] The groups were still just emerging. Without favorable policies, the EVs would lose their market advantage to other existing vehicles – to the Vikrams before the Vikram ban and to LPG vehicles and microbuses after the ban. This was an indication of EVs' insecure foothold. Thus, the protection should have lasted at least until EVs no longer required incentives from the government to maintain a strong presence in a niche in the market.

Phased ban on polluting vehicles

A *phased* ban on polluting vehicles would be better suited for introducing EVs in the market to displace them. The present research shows two key ramifications of the

---

[248] Interviews: Bimal Aryal, Bikash Pandey, Rajendra Adhikari, all EV manufacturers; Devtec Nepal P. Ltd. 2001. Even some officials from the Ministry of Population and Environment admit this.
[249] Kemp, R., Schot, J., and Hoogma, R. 1998; Kemp, René. 1997. http://www.jrc.es/projects/snm/utrecht3.rtf.
[250] Almost every interviewee agreed on this.
[251] This include only bus, minibus, and three-wheelers, and excludes cabs, trucks, and other private vehicles; Klaus, B. and Pradhan, N. 2001.

immediate ban of polluting vehicles, the Vikrams tempos, and the sudden growth of new zero emissions electric vehicles. The immediate ban on the Vikrams created a gap in public transportation. This gap likely lent a bargaining chip to the opposing groups to induce the government to import microbuses and also created room for LPG vehicles to proliferate. On the other hand, taking advantage of the short-term gap, the EV manufacturers indulged in multiplying EV numbers, paying little attention to improving the quality of the industry.

A phased ban would have supported incremental growth for the EV industry, allowing time to test and learn about the technology and improve upon it. This also would have provided the government time to reflect on mistakes and correct them before they became unmanageable. For example, when the Ministry of Population and Environment took corrective measures by withdrawing all the subsidies to LPG vehicles in 2001, the EV market had already failed.[252] Above all, the phase-wise ban would have prevented the failure of the EV industry. Further, the entry of microbuses would never have been a necessity because the pressure of the elimination of 100 or 200 Vikram tempos would count far less than 600 Vikram toward helping the diesel groups to exert bargaining power. According to Martin Chautari, there would have been an expansion of EV that exceeded 1,500 if there had been no microbuses.[253]

Preferential treatment

There should be a clear distinction between polluting and zero-emissions vehicles in the transport policies of government. A major flaw of the policy regime that caused EV failure was clearly the same "preferential" treatment, such as subsidies, for both non-polluting EVs and polluting microbuses and LPG vehicles. This made EV lose its competitive advantage to the cheap vehicles and instigated supposed market saturation. This became "subsidizing people to pollute," rather than making "polluters pay."[254] Experts claimed that the subsidies to polluting vehicles incurred a huge loss for the government: loss of US$ 7,095,200 by the importation of polluting microbuses, loss of

---

[252] Interview with Janak Raj Joshi and Bimal Aryal.
[253] Parajuli, Ramesh. AFV News. March 1, 2001.
[254] During interviews, many EV advocates and stakeholders quote this phrase.

US$ 4,257,100 by the importation of tuk tuks, and US$ 510,856 by the cross subsidy for LPG fuel.[255]

The government's inability to penalize polluting behavior is a key reason why EVs have not been able to attract conventional transportation entrepreneurs.[256] For example, the Vikram conversion to electric power in 1998 failed because there was no penalty for operating Vikram tempos. Had their polluting behavior been penalized rather than subsidized, entrepreneurs might have thought about "switching from polluting products to environmentally friendly substitutes."[257]

From an economic perspective, EV technology should compete in the free market. Providing subsidies only distorts the market and causes inefficiency. This is what the Department of Transport Management seems to uphold, as indicated by their one-tiered policy for all vehicles that meet the vehicular standards.[258] But EV advocates argued that this approach would be reasonable only if it accounted for all environmental costs and benefits of both fossil-fuel vehicles and EVs and also if the government effectively enforced standards. But these are missing.[259] "In the diesel world, all the profits are privatized and all liabilities such as health problems are publicized. How are things justified here?" says Friedensohn. Therefore, for framing better future polices, a thorough cost-benefit analysis of these vehicles is needed.

As we discussed early on, the EV industry generates a number of economic and environmental benefits for Nepal at the macro level. Nepal generates hydroelectricity based on run-of-river (ROR) generation which amounts to nearly zero-emissions energy.[260] Using this clean indigenous energy for transportation would be a major cost relief to its import-dependent fossil-fuel economy. The expenditure on petroleum

---

[255] Parajuli, Ramesh. AFV News. March 1, 2001; the exchange rate is US$1 = NPR 78.6 (as of May 2002)
[256] Interview Bimal Aryal, Madhav Ghimire and Cheeranjivi Gautam.
[257] Panayotou, Theodore. 1998. Pp:30-32
[258] Interview with Sushil Agrawal.
[259] Interview with Madhav Ghimire (Ministry of Finance) and Janak Raj Joshi (Ministry of Population and Environment).
[260] Interview with Binayak Bhadra and Ashok Pandey,

imports for transport vehicles is rising (it rose 16% from 2000 to 2001).[261] In the previous section, we cited US$ 309,902 as extra income for the Nepal Electricity Authority that was earned through the EV industry. Through improved air quality, the expenditure on health would be lowered and the general life of the population would be improved. As was mentioned earlier, the vehicular emissions incurred about US$10 million extra costs for the government annually (refer to Part I). Also, a 1997/1998 study indicated that air pollution in the Kathmandu Valley was causing an estimated 394 cases of adult chronic bronchitis, 3,771 cases of bronchitis in children, and 14,675 cases of asthma per year.[262]

Eco-tourism loss is also a concern. As was indicated, the tourism industry has constituted a significant portion of national income (around 4.1 % of the GDP). Major cities such as Kathmandu and Patan are choked in diesel fumes because of traffic congestion and polluting vehicles.[263] In addition, there would also be enforcement savings to the government because EVs do not require emission testing.[264] With these tangible and non-tangible benefits, EVs deserve exclusive preferential treatment from the government. This special treatment varies from obtaining exclusive routes of operation, special VAT and import incentives, and niche applications such as tourist pick-up and touring. EVs can be a part of the mandate of every ministry or agency that directly and indirectly benefits from its use. Hence, the benefits of EVs need to be investigated and made a basis for crafting future policies. A thorough cost-benefit analysis of electric vehicles may prove that the success of EV can bring huge national savings. Incorporating these savings in the national budget can provide impetus for the government to adopt EV-supportive policies.

Organizing the Interests of the Private Sector

Efforts for better policies would be in vain if the private sector did not organize efficiently to capture the general interest of the EV industry. The private actors are inherently profit seeking, and as such want to maximize their profits through any possible way they deem fit. They pursue different interests for making profit and as such would

---

[261] National Planning Commission. Economic Survey 2000/2001. 20001
[262] Cited in Baral et al. 2000.
[263] General Observation; Ministry of Population and Environment, 2000.
[264] Ministry of Population and Environment, 2000.

take on different roles. For example, the private sector actors took various roles as manufacturers, charging station owners, drivers, operator-entrepreneurs, battery dealers, and repair and maintenance providers to make profit out of EV. The dynamics of the interests of these private actors show that their disparate economic interests can cause inefficiencies in the EV management when these interests do not coincide.

How to harmonize disparate economic interests? As we saw, there were three distinct elements in the various roles they undertook: ownership, control, and knowledge. Since these interests are rooted in maximizing benefits, solutions can be sought by applying the principle of Liability Rules. The Rules say, "correct inefficiencies by forcing those who cause damage to bear the cost of that damage."[265] Therefore, private actors can overlap their interests by aligning these three elements in their functions. For example, if drivers own and take control of the vehicles, they will have incentives to handle vehicles properly because the cost of abusing vehicles is no longer external to them. Previously, they had no interest in doing so. If the private actors align the three elements, or at least the liability with one of the two others, their previously externalizing behavior would be internalized in their function and their different interests would be aligned. They would then maximize their profits only if their interests overlapped. Consider the case of drivers' behavior.

Since the driving behavior of drivers determines the range per battery charge,[266] drivers have a central role to play in the EV operation. In a context where there are high chances of vehicle misuse by drivers, only giving them both liability and control of the vehicle would result in better vehicle and battery performance. This would mean they could maximize their economic interests only if they drove as well as maintained their vehicles and batteries. Some experts have claimed that owner-driver management would increase incomes for a single EV by up to 70%. At the same time, the proper care and maintenance of vehicles and EV batteries would be assured.[267] (But again, this will be

---

[265] Tietenberg T. 2000. Pp-81.
[266] Kemp, R., Schot, J., and Hoogma, R. 1994.
[267] Interview with Ashok Pandey. .

insufficient if driver-owners are not skilled drivers and managers. See the subsequent section on human resources.)

Similarly, vehicle leasing, [268] rather than selling, by manufacturers can also allocate ownership to the ones who have knowledge and are in a better position to address the problems of vehicles and batteries. In this way, manufacturers will be more likely to attend to the need for committed and adequately prepared entrepreneurs coming into the EV industry. Also, in case of mechanical faults, the vehicles are more likely to receive quick attention.

Who can coordinate these various functions? For this, the private actors should form a working network amongst themselves. The present research found that the lack of such a network made them unable to identify and attend to problems. Toward the end of Phase III, we saw that Electric Vehicle Association Nepal, an umbrella network for EV, came into being, but without much effectiveness. Such a network should be functional as a facilitating body which organizes the relationship among EV stakeholders, such as CLEAN, EVMAN, and NEVCA, in our case. This network must assure adequate problem-centered interaction among all EV actors and develop appropriate packages to enhance such interactions. It should expand to include other EV stakeholders, such as drivers, battery and part dealers, workshop and maintenance groups, and consumer groups, to overcome many management and technical problems that are likely to surface during the development. Additionally, this network should work in close coordination with the coalition proposed in the previous section. This networking is crucial to surmounting many of the obstructions of the opposing groups.

A recently envisioned lease-to-own program called "battery-leasing system" serves as an example of a network-building package which brings about problem-centered interaction. The specialty of the system is the formation of a working network among drivers, charging station owners, and operator-entrepreneurs, in which the charging station owners take full control of the vehicle operation and battery charging, while also

---

[268] Vehicle leasing is one of the market strategies proposed by Gärling, Anita and Thøgersen, John (2001)

monitoring and supervising drivers. Hence, in addition to allocating liability to the charging station owners, it also requires charging station owners to get involved in problem-centered interaction through monitoring and supervision. In this network, the owners lease out vehicles to charging station owners (not drivers), who thus have both economic interest and liability for the health of the vehicles and batteries. The charging station owners have to take care of both -- otherwise they would lose their investment. However, this network should not be considered complete because it does not extend to other essential actors such as manufacturers. Manufacturers have knowledge about the technology, and as such should be an integral part of this type of network. Encouraging investment is one way to bring the manufacturers and other players into this network.

However, forming a network alone does not necessarily imply that the disparate interests will be aligned. As we found, the EV actors claimed that their varying interests were a barrier to the efficacy of EVAN. Hence, forming an effective network requires negotiation for building a common interest through mutual benefit. According to Coase theorem, the parties can negotiate an efficient mutually beneficial outcome even without transferring their ownership if there is no cost involved in the negotiation.[269] Therefore, conflict resolution should be an integral function of this network. Who should facilitate this negotiation? Forming a conflict resolution group within the network is one way. From the outside, an NGO-front-ended strategy of the private sector would provide credibility to environmental NGOs for facilitating the negotiation process. In addition, the proposed coalition as a whole could host another facilitating body.

Building the Human Resource Capacity of the Industry

Building the human resource capacity is crucial for sustaining the EV technology. This research shows that private actors failed to understand the EV technology in terms of its battery use, battery charging, and vehicle maintenance and repair. As a result, the EV actors experienced successive technical failures such as short life span of batteries, frequent vehicle breakdowns, and failure to maintain the technology.

---

[269] Tietenberg, T. 2000.

But who should build this capacity? We saw that private actors, in haste, made quick returns on investments from EVs, but made no attempts to transfer adequate knowledge or hire and build skilled human resources. Given the quick-profit-seeking mentality of the private actors, they are less likely to invest in such ventures that do not provide tangible quick benefits. Moreover, they might not have the funding and technical capacity to engage in capacity-building efforts at the beginning of the EV implementation. Therefore, human resource development is the area in which the private sector should seek external initiatives. The international donors and environmental NGOs should take these initiatives. Both donors and NGOs are inherently non-profit-seeking. While environmental NGOs possess information and can mobilize resources,[270] international donors have both technical know-how and money. For example, some environmental NGOs like NEED and Samuhik Sewa have provided training to drivers. Also, DANIDA recently introduced Environmental Sector Program Support (ESPS) to strengthen EV-related associations and to train new EV drivers, charging station personnel, and EV mechanics.

For environmental NGOs support, the initial proposition of NGO-front-ended private sector efforts will be highly attractive. However, we also discussed the lack of NGO resources -- both human and monetary. Environmental NGOs should use the proposed coalition efforts to build partnerships with international donors that channel donor resources to developing training programs and centers. These NGOs should also strengthen their capacity by joining the networks of international environmental NGOs and international EV-related associations, and multi international donor organizations. By expanding their capacity, they should also be bale to play crucial roles in negotiations support.

To activate more donor support, the proposed coalition should coordinate donor interests. Because of the importance of carbon emissions reduction through Clean Development Mechanisms, the EV sector provided a promising avenue for international donors to

---

[270] Sagar, A.D. 2000

direct their funds for producing "certified emission reduction."[271] The Clean Development Mechanisms for carbon emission reduction facilitate the private companies in developing countries to coordinate with a host country sponsor to invest in an emission reduction project.[272] The coalition can use Clean Development Mechanisms as a strategy to attract donor funding for capacity building as well as for research and development. Thus, the potential of using such a strategy should be thoroughly investigated.

[271] Artuso, Christo. 2001
[272] Artuso, Christo. 2001

Conclusions

The lessons learned from Kathmandu can also be applied to other contexts in developing countries. Vehicular air pollution is a concern for every growing city. The use of alternative fuel vehicles such as electric vehicles is gaining importance. For cities that wish to introduce electric vehicles as part of a strategy to curb air pollution problems, Kathmandu's EV experience offers some important insights concerning implementation. Although cities are my interest, some of the actions must seek initiatives at the state and national level.

There is a need to build a coalition of supporting actors for electric vehicles. The fossil-fuel vehicles have dominated the transportation sector for nearly a century and can be very powerful in resisting EV penetration. Without advocacy and lobbying, any effort to implement a program is not likely to be successful. The NGOs are catalysts of reforms and should take leadership in forming coalitions. In building collective pressure against opposition, they should partner with the private sector, like-minded government bodies and concerned international donors. Although the context in which this opposition operates is different in each country, public policy is often used as a tool to obstruct progress. In places where corruption prevails, some sections of the government at the central level can emerge as part of the opposition. This makes coalitions all the more important in inducing political will and acquiring better policy commitment from all levels of the government. On the actual implementation level, a recommended approach will clearly be an NGO-front-ended effort for the private sector.

Government commitment for EV-supportive policies is indispensable for the success of EV implementation. Competing successfully with highly entrenched fossil-fuel vehicles will be unlikely unless the government is committed to providing protection for the new technology. When, as in conventional accounting, all externalities are ignored, the cost of EV can represent the single factor most in need of governmental incentives and support. This initiative requires state and national government involvement. Hence, the state and national policy design must consider the broader picture of environmental benefits and the importance of learning and reflection to sustain EV technology. EV

application can have many benefits depending on the aspirations and the resource availability of each location. For a region that is rich in hydro-electricity and aims toward eco-tourism, the national government has an even greater role to play in advancing EVs for national savings.

Another important insight concerns the problems of the disparate economic interests of the private actors. The private actors are professional executers, and as such are sought for program implementation everywhere. In order to effectively manage EV implementation by the private actors, a careful understanding of their profit-seeking goals is crucial. Even technically and commercially viable technologies will fail if their interests do not align to serve the general interest of that technology. The actor behavior, position, and capacity as well as their operating environment will determine their economic goals and hence the outcome of any implementation initiatives. The EV advocates should consider these factors while recommending EV management. A multi-function network amongst the private actors is one way to promote effective interaction that solves problems and builds consensus. This is important because differing interests create inefficiencies in EV management.

The final insight is the need to build human resource capacity for EV technology. The effective management of a new technology means acquiring new knowledge and new skills to respond to the needs of the development. Private actors, on their own, may overlook the importance of training and education if they see no tangible benefits for their investment. Relying on the private sector to develop their own training capacity is likely to fail. The EV advocates should seek external initiatives from environmental NGOs and international donors. This insight holds particular relevance for developing countries in which international donors play a crucial role in their development. Because of monetary and technical expertise, donors can play key roles in the capacity building and training of the private sector. Channeling their technical know-how and financial capital can fill in gaps that the private sector, local NGOs, and the government are unable to fill.

To conclude, without long-term vision and commitment from all EV stakeholders, EV development cannot be sustainable. Ultimately, the private sector should be the most responsible for the EV industry because government protection and NGO and donor support are not everlasting. Additionally, stakeholders in the private sector have the potential to be the biggest entrepreneurs of EV technology, and therefore to wield the greatest impact on EV success. Therefore, appropriate policies must be in effect if private stakeholders are to become more proactive and innovative in the advancement of EV technology.

Bibliography

A Post Reporter. "CLEAN submits memo to PM." The Kathmandu Post: a Daily. October 29, 1998.

A Post Reporter. "SAFAs Don't Get Clean Treatment." The Kathmandu Post: a Daily. November 1, 1998.

A Post Reporter. "Smoke-Free Vehicle in Smoky Kathmandu." The Rising Nepal: a Daily. February 24, 1996.

Martin Chautari. AFV News: 1999 - 2000. Alternative Fuel Vehicle in Nepal. Kathmandu.

Agenda 21(Chapter 34): http://www.un.org/esa/sustdev/agenda21chapter34.htm

Artuso, Christo. 2001. "The Clean Development Mechanism. Reforming the International Environmental Treaty-Making Systems." PON Books: Edtrs. Susskind, L., Moomaw, W., Gallagher, K., and Corell, E. 2001.

Arya, R. "How Environment-Friendly are LPG Vehicles?" The Kathmandu Post: A Daily. March 20, 2001.

Aryal, B. Media and Air Pollution. Martin Chautari. 2002.

Aryal, B., Baral, A., and Parajuli, R. Bottlenecks in the Proliferation of Electric Vehicles in Nepal. Martin Chautari: Electric Vehicle Promotion Project. January 1999.

Baral, A., Parajuli R., and Aryal B. 2000. Institutional Responses to Electric Vehicle Promotion in Nepal. Martin Chautari: Electric Vehicle Promotion Project. Pp-7.

Baral, A., Parajuli R., and Aryal B. EV Advocacy Project (Phase VII). Martin Chautari: Electric Vehicle Promotion Project. July 2001. 2000.

Battery Council International: http://www.batterycouncil.org/recycling.html

Bhadra, B. Hydro-Energy For National Development. International Center for Integrated Mountain Development. Kathmandu. 2002.

Broersma, Klaus and Pradhan, Naresh. Passenger Travel Demand & Modal Spit Estimation Kathmnadu Valley: Mission Report. Kathmandu Valley Mapping Project. Kathmandu Metropolitan City and Commission of the European Communities. Kathmandu. November 2001.

Callon, M. "The State and Technical Innovation: A Case Study of the Electric Vehicle in France." Research Policy 9: 358-376. Centre De Sociologie De L'Innovation, Ecole Des Mines, Paris, France. 1980.

Changqi Wu, Strategic. 1992. Strategic Aspects of Oligopolistic Vertical Integration. Mathematical and Managerial Economics series. Vol. 36. Amsterdam: North-Holland.

Cohen, M. & Moulton, P. Promoting Electric Vehicles in the Developing World. International Electric Vehicle Conference, San Jose, Costa Rica. November 1998.

Cohn, R.S. Electric Vehicle Life Cycle Analysis. MIT Thesis. May 1994.

DANIDA. Project Completion Report. July 2000.

Devtec Nepal P. Ltd. Current Status Survey of Three-Wheeled Electric Vehicles (Safa Tempo) of Kathmandu Valley and Appraisal Study of Operating The Electric Vehicles of Some Sub-Metropolitan Cities in Nepal. HMG/N Ministry of Population and Environment. Environment Sector Programme Support/DANIDA. December 2001.

Dosi, G., Freeman, C., Nelson, R., Silverberg, G, and Soete, L. Technical Change and Economic Theory. Pinter Publishers. 1988.

Edtrs. Smillie, I., Helmich, H., German, T., and Randel, J. Stakeholders Government-NGO: Partnership for International Development. Organization of Economic and Development. EARTHSCAN. 1999

Eisenring, Markus. Assistance to the Electric Vehicle Sector in Nepal: Report. Swiss Development Corporation. July 2000.

Environmental Treaty-Making Systems. PON Books; Toman, M. & Cazorla, M. 1998. The Clean Development Mechanism: A Primer. 2001

Faiz, A., Weaver, C. S., and Walsh, M. P. Air Pollution from Motor Vehicles: Standards and Technologies for Controlling Emissions. The World Bank, Washington, D.C. 1996.

Federation for Real Clean Locomotive Entrepreneur's Association of Nepal (FORCLEAN). "Regarding Raising the Matter of Co-operative." Letter to ESPS/DANIDA (No. 360). 28 Aug 2001.

Fowler, A. Striking a Balance: A Guide to Enhancing the Effectiveness of Non-Governmental Organizations in International Development. EARTHSCAN. 1997.

Friendensohn, A. "The Electric Vehicle Reality: Good Ideas/Heavy Obstacles." Spotlight Business Magazine. April 1999.

Gärling, Anita and Thøgersen, John. "Marketing of Electric Vehicles." Business Strategy and the Environment. 10: 50-65. 2001.

Gautam, S. P. and Onursal, B. Vehicular Air Pollution: Experiences from Seven Latin American Urban Centers. World Bank Technical Paper No. 373. The World Bank. Washington, D.C. 1997.

Giri et al. Urban Air Quality Management Strategy in Asia: URBAIR Kathmandu Valley Report. Metropolitan Environment Improvement Program: A World Band Initiative. Pp-8-9. The World Bank, Washington, DC. October, 1996.

Hansen, E and Shrestha, B.R. Study on Environmentally Benign Handling, Disposal, and Recycling of Used Lead Acid Batteries in Nepal: Review Report. DANIDA. September 2001.

http://www.un.org/esa/sustdev/agenda21chapter34.htm

Intergovernmental Panel on Climate Change. Methodological and Technological Issues in Technology Transfer. UNEP & WMO. Cambridge University Press. 2000.

Interviews

Kemp, R., Schot, J., and Hoogma, R. "Regime Shifts to Sustainability Through Processes of Niche Formation: The Approach of Strategic Niche Management." Technology Analysis & Strategic Management 10(2). June, 1998.

Kemp, R., Schot, J., and Hoogma, R. "Strategies for Shifting Technological Systems: The Case of the Automobile System." Futures 26(10): 1060-1070. 1994.

Kemp, René. "Conclusions SNM Workshop in Utrecht." October 8, 1997. http://www.jrc.es/projects/snm/utrecht3.rtf.

Kemp, René. "Technology and The Transition to Environmental Sustainability: The Problem of Technological Regime Shifts." Futures 26(10): 1023-1046. 1994.

Laws, D., Susskind L., Abrams, J., Anderson, J., Chapman, J., Rubenstein, E., and Vadgama, J. Public Entrepreneurship Networks. Department of Urban Studies and Planning: Environmental Technology and Public Policy Program. MIT. April 2001.

Lieberman, Joseph. "Electrifying Kathmandu: Eugene exports life-saving technology." Eugene Weekly. Eugene. 2001. http://www.eugeneweekly.com/03_22_01/news.html#news3

Lonely Planet: Destination Kathmandu: http://www.lonelyplanet.com/destinations/indian_subcontinent/kathmandu/

Lundgren, Annika. Solar Photovoltaics in Developing Countries: Expanding the Private Market through Multi- and Bi-lateral Programs: Thesis. Department of Urban Studies and Planning, MIT. February 1999.

Malinsovsky, M. "Air Quality Management in Kathmandu Valley: A Component Under the HMGN/DANIDA Environment Sector Programme Support." Environment: A Journal of the Environment. Ministry of Population and Environment. June 2001.

Martin Chautari. "Good News for the Prospective EV Buyer." AFV News. Alternative Fuel Vehicle in Nepal. Kathmandu. August 3, 2000.

Martin Chautari. "Interaction Program on EVs in Next Millennium and Experience of Electric Tempos in Nepal." AFV News. Alternative Fuel Vehicle in Nepal. Kathmandu. December 9, 1999.

Martin Chautari. "LPG Vehicles Are As Polluting As Gasoline." AFV News. Alternative Fuel Vehicle in Nepal. Kathmandu. February 15, 2000.

Martin Chautari. "More Electric Vehicle in the Streets of Kathmandu." AFV News. Alternative Fuel Vehicle in Nepal. Kathmandu. February 9, 2000.

Martin Chautari. "State of Charger Manufacturing in Nepal." AFV News. Alternative Fuel Vehicle in Nepal. Kathmandu. February 3, 1999.

Martin Chautari. "Apex Court to Decide on LPG Powered Vehicles." AFV News. Alternative Fuel Vehicle in Nepal. Kathmandu. April 27, 2001.

Martin Chautari. "Batteries." AFV News. Alternative Fuel Vehicle in Nepal. Kathmandu. September 16, 1999.

Martin Chautari. "Good News for the Prospective EV buyer." AFV News: Alternative Fuel Vehicle in Nepal. Kathmandu. August 3, 2000.

Martin Chautari. "Government's Unfair Decision Regarding Electric Vehicles." AFV News: Alternative Fuel Vehicles Nepal. October 26, 2000.

Martin Chautari. "State of Charging Stations in Nepal." AFVs News. Alternative Fuel Vehicle in Nepal. Kathmandu. March 16, 2000.

Martin Chautari. "Will the Government Hear This?" AFV News. Alternative Fuel Vehicle in Nepal. Kathmandu. March 1, 2001.

Martin Chautari. EV Advocacy Project : Phase VII. Kathmandu. July 2001.

Martin Chautari. Subsidy to Import Polluting Vehicles: Crores of Revenue in Vain. March 3, 2001.

Ministry of Physical Planning and Construction. National Transport Policy: 2002. MoPPC.

Ministry of Population and Environment. "Status of Safa Tempo and Charging Station Loan." Bank Report. 2002.

MoF. Budget Speech (Fiscal Year 1995/1996). Ministry of Finance. Kathmandu 1995/1996.

MoF. Budget Speech: From 1995 to 2000. Ministry of Finance.

MoPE. 2000. State of Environment: Nepal. Ministry of Population and Environment. Kathmandu. Pp-82.

MoPE. 2000. State of Environment: Nepal. Ministry of Population and Environment. Kathmandu. Pp-82.

MoPE. Environment Day 2001: Booklet (Draft). Ministry of Population and Environment. 2001

National Planning Commission. Economic Survey 2000/2001. NPC. Kathmandu. 2001

NPC. Ninth Plan (1997-2002). National Planning Commission. Kathmandu. 1998.

OECD. Electric Vehicle Technology, Performance, and Potential. International Energy Agency. Organization of Economic and Development. 1993.

OECD. Managing Technological Change in Less-Advanced Developing Countries. Organization for Economic Co-operation and Development. 1991.

Organization for Economic Cooperation Development International Energy Agency. The Urban Electric Vehicle: Policy Options, Technology Trends, and Market Prospects.

Palanchowki, R. "Technical and Financial Viability of EVs in Kathmandu Valley." Clean Energy NEWS: Vol 2(18). April 2, 2002.

Panayotou, Theodore. Instruments of Change: Motivating and Financing Sustainable Development. UNEP EARTHSCAN. 1998.

Pandey, Ashok R. "Issue Related to Safa Tempo." AFV News: Alternative Fuel Vehicles Nepal. November 9, 2000.

Pandey, B. "An Opportunity Lost." The Kathmandu Post: a Daily. 15 September 1999.

Parajuli, Ramesh. "Will the Government Hear This?" Alternative Fuel Vehicles Nepal: AFVs News. 1 March, 2001.

Pindyck, R. S. and Rubinfeld, D. L. Microeconomics: Fourth Edition. Prentice Hall. 1998.

Pradhan, Naresh & Broersma, Klaus. Passenger Travel Demand & Modal Split Estimation in Kathmandu Valley: Mission Report. Kathmandu Valley Mapping Programme. Kathmandu Metropolitan City and Commission of the European Communities. November 2001.

Princen, T. & Mattias F. Environmental NGOs in World Politics. Routledge. 1994.

Proceeding of An International Conference Stockholm, Sweden 25th-27th May 1992. OECD Document. 1992.
remit

Rip, A., Thomas, M. J., and Schot, J. Managing Technology in Society: The Approach of Constructive Technology Assessment. Pinter Publisher. 1995.

Rip, Arie. Introduction to New Technology: Making Use of Recent Insights from Sociology and Economics of Technology. Technology Analysis & Strategic Management 7(4): 417-431. 1995.

Roy, R, Gurung, S., and Bam, P. "A Social Dynamics of Launching Safa Tempos in Kathmandu Valley: A Campaign Against the Air Pollution." Environment: A Journal of the Environment. Ministry of Population and Environment. June 2001.

Sagar, A. D. "Capacity Development for The Environment: A View for the South, A View for the North." Annual Review Energy Environment 25: 377-439. 2000.

Schot, J. Towards New Forms of Participatory Technology Development. Technology Analysis & Strategic Management. March 2001.

Schot, Johan W. "Constructive Technology Assessment and Technology Dynamics: The Case of Clean Technologies." Science, Technology, & Human Values 17(1): 36-56. Winter 1992.

Sharma, Usha. "Study on LPG: Study Report." Clean Energy Nepal. 2001

Skeer, Jeffrey. "Electric Vehicles, Energy, and Environment: Rapporteur's Report." The Urban Electric Vehicle: Policy Options, Technology Trends, and Market Prospects. Proceedings of an International Conference, Stockholm, Sweden, 25-27 May 1992. Paris OECD/IEA. 1992. Pp-159-170.

Sperling, Daniel. Future Drive: Electric Vehicles and Sustainable Transportation. Island Press. Washington, D.C. 1995.

The Kathmandu Post. "Embassy Irked by Ban on 3-Wheelers." The Kathmandu Post: Daily. June 3, 2000.

The Kathmnadu Post. "SAFAs Don't Get Clean Treatment." The Kathmandu Post: Daily. November 1, 1998

Tietenberg, Tom. Environmental and Natural Resource Economics: Fifth Edition. Addison-Wesley. 2000. Pp-483

Verheul, H. & Vergragt, P. J. Social Experiments in the Development of Environmental Technology: A Bottom-up Perspective. Technology Analysis & Strategic Management 7(3). 1995.

Weber, Matthias and Dorda, Andreas, D. "Strategic Niche Management: A Tool for the Market Introduction of New Transport Concepts and Technologies." The IPTS Report 31. February 1999.

Yogi, Bhagirath. "Unclean Attitude: Safa Tempos." Spotlight: Weekly Magazine. Kathmandu. June 9, 2000.

.....Kathmandu. Lonely Planet. 2000.

Annex 1: List of Interviewees

Interview (written and spoken) conducted from January 24 to February 11, 2000.

S. No.	Date	Name	Position	Organization/Agency/Company	Location
1	March 15	Peter Moulton	Chairman	Global Resources Institute	Oregon, U.S.A
2	March 15	Marilyn Cohen		Global Resources Institute	Oregon, U.S.A
Private Actors					
3	January 24	Adam F. Friedensohn	Chairman	Lotus Energy Pvt. Ltd.	Kathmandu, Nepal
4	January 24	J. R. "Jeevan" Goff	Managing Director	Lotus Energy Pvt. Ltd.	Kathmandu, Nepal
5	January 26	Ashok Pandey	Chairman Director General	Electric Vehicle Manufacturing Association Nepal (NEVMAN) Nepal Electric Vehicle Industry (NEVI)	Kathmandu, Nepal
6	January 25	Hridaya Manandhar	Chairman	Electric Vehicle Association Nepal (EVAN) Nepal Electric Battery Charging Association (NEBCA)	Kathmandu, Nepal
7	January 31	P. P. Pokharel	Managing Director	Electric Vehicle Company (EVCO)	Kathmandu, Nepal
8	January 26	Ramesh Man Singh	Managing Director	Bagmati Electric Vehicle For Environment Pvt. Ltd.	Kathmandu, Nepal
9	January 25	Puskal Rana	Managing Director	Om Sai Ram Battery Charging Station	Kathmandu, Nepal
10	February 2	Dick Bhola Rai (also owns vehicles)	Managing Director	Shakela Charging Station	Kathmandu, Nepal
11	February 2	Megh Nath Rijal	Owner Entrepreneur		Kathmandu, Nepal
12	February 4	D.B. Limbu	Chairman (Operator entrepreneur)	Clean Locomotive Electric Vehicle Association Nepal	Kathmandu, Nepal
Government					
13	February 4	Sushil Agrawal	Technical Director	Department of Transport Management	Kathmandu, Nepal
14	February 5	M. P. Ghimire	Director General	Departments of Customs, Ministry of Finance	Kathmandu, Nepal
15	January 29	M.P. Ghimire	Joint Secretary	Ministry of Finance	Kathmandu, Nepal
16	February 7	Janak Raj Joshi	Joint Secretary	Ministry of Population and Environment (MoPE)	Kathmandu, Nepal
17	February 8	Sherjang Karki	Environment Law Officers	Ministry of Population and Environment (MoPE)	Kathmandu, Nepal
18	January	Bidhyadhar Mallik	Director General	Inland Revenue Department	Kathmandu,

	30				Nepal
19	February 11	Jagdish Chandra Pokhrel	Member	Planning Commission	Kathmandu, Nepal
20	February 7	Ramchandra Maharjan	Deputy General Manager	Agricultural Development Bank	Kathmandu, Nepal
NGOs					
21	January 31	Bikash Pandey	Country Representative	Winrock International Nepal	Kathmandu, Nepal
22	January 22	Ratna Sansar Shrestha	Senior Advisor	Winrock International Nepal	Kathmandu, Nepal
23	February 10	Bhoj Raj Ayer	Public Interest Lawyer	PRO Public, Forum for Protection of Public Interest	Kathmandu, Nepal
	February 11	Bimal Aryal	Researcher	Martin Chautari, Electric Vehicle Promotion Project	Kathmandu, Nepal
24	February 8	Usha Sharma	Consultant	The World Conservation Union Nepal	Kathmandu, Nepal
25	January 29	Bhushan Tuladhar	Executive Director	Clean Energy Nepal	Kathmandu, Nepal
Others					
26	January 28	Padma Sunder Joshi	National Co-Director	Kathmandu Valley Mapping Programme Kathmandu Metropolitan City	Kathmandu, Nepal
	January 31	Rajesh Manandhar	Chief	Solid Waste Division, Kathmandu Metropolitan Corporation	Kathmandu, Nepal
27	February 7	Naresh Pradhan	Planning Officer	District Roads Support Programme, Swiss Development Corporation	Kathmandu, Nepal
28	February 6	Deepak Bahadur Shrestha	D.S.P	Valley Traffic Police	Kathmandu, Nepal
29	February 7	Binayak Bhadra	Deputy Director General	International Centre for Integrated Mountain Development (ICIMOD)	Kathmandu, Nepal
30	January 30	Poshan Bahadur KC		Institute of Environmental Management DANIDA/Environment Sector Programme Support	Kathmandu, Nepal
International Donors					
31	February 8	Mikael Malinovsky	Technical Director	Environment Sector Program Support(ESPS)/DANIDA	Kathmandu, Nepal
32	January 24	Cheeranjivi Gautam	Advisor	Environment Sector Program Support(ESPS)/DANIDA	Kathmandu, Nepal
33	February 4	Sharad Neupane	Senior Program Officer	Danish International Development Agency	Kathmandu, Nepal
I also interviewed 3 drivers and 14 commuters.					

Annex 2: Interview Questions

Private EV Actors

1. What kinds of government policies and regulations have stimulated interest and production of EV? Are these policies sufficient? Please explain.
2. How have these policies and regulations worked (or not worked)? Please explain.
3. What is your opinion of the current policies toward EV? What shortcomings do you find in these policies? Please describe.
4. What would make EVs a more popular investment for entrepreneurs and consumers living in the Kathmandu Valley? And why?
5. What incentives do you think would best support EV promotion? And how?
6. What the efforts of your agency are to dealing with the existing obstacles as well as with the new challenges of EV? Do you collaborate with other stakeholders to undertake these efforts? Please explain.
7. How much is your agency aware of the possible environmental impacts of EV? How much capability does your agency have to address these impacts, in particular the issues associated with battery disposal?
8. How has your agency been affected by government efforts to promote EV?
9. Is there anything else you would like to add on the efforts to bring EV to the valley?

Government

1. What is the current policy of your agency toward the development of EVs in Nepal? Please outline.
2. How does your agency intend to address the existing obstacles to expand the use of EVs? What efforts need to be initiated to address these obstacles? Please describe.
3. What obstacles does your agency face in adopting EV-supportive policies? Please explain.
4. What measures, programmes and activities can best help to create a political environment conducive to EV expansion? Please explain.
5. Does your agency, at present, prioritize the importance of hydropower in EV sector? If yes, how?
6. Do you interact with other agencies (governmental, private and non-governmental) while making EV related policies? If yes, how and why?
7. What options are there for your agency to promote EV?
8. Do you think the current policies of your agency toward EV development are sufficient? If not, please explain the areas of improvement?

NGOs

1. How has your organization played a role in the promotion of EV technology? Please explain.
2. How has your organization been involved in government efforts to promote EV? Please explain.
3. How has your organization managed to bring the issues of vehicular air pollution problems in the local EV decision-making? Please describe.

4. How does your agency lobby for inconsistent and contradictory policies of the government toward EV? Please explain.
5. What are the main elements of your advocacy? How have these elements been effective? Please explain.
6. Lastly, is there anything else you would like to add on the efforts to bring EV to the valley?

International Donor (Danish International Development Agency)

1. What role is your agency playing in the EV promotion? What additional role can your agency play? Please explain.
2. What are the barriers that your agency faces in participating fully in the EV development effort in Nepal? Please explain.
3. What is your opinion of the current policies toward EV? What shortcomings do you find in these policies? Please describe.
4. How does your agency intend to address the existing obstacles to expand the use of EVs? What efforts need to be initiated to address these obstacles? Please describe.
5. What are your current programmes and activities in this sector? How effective are these programmes and activities?
6. What influence does your agency have on the government for making enabling policy environment for EV development? Please explain.
7. How does your agency interact with local entrepreneurs?