

Electric Vehicle Design Initiatives in India & some Case Studies

Abstract: The growing environmental consciousness and seeing the adverse effects of climate change, the governments in India are supporting initiatives for development of eco-friendly mobility solutions including electric vehicles. To offset the disadvantages of electric vehicles regarding range, weight and charging time, efforts have to be made to orient the use of electric vehicles to niche situations and niche markets where these limitations can be leveraged by design. Confined spaces like airports, industrial campuses, gated communities lend themselves easily to vehicle electrification. When the technology does not offer major physical constraints as in electric vehicles in comparison to the traditional vehicles, design criteria will have to be predominantly use oriented - psycho-physiological, cultural, contextual and environmental. The physiognomy / aesthetics of electric vehicles can be and should be quite different from what we see today in cars or hybrid vehicles to depict the uniqueness of this breed of products. In this presentation some design case studies based on the above would be discussed.

Keywords: Urban renewal, leveraged by design, vehicle electrification, Research-shy companies, physically pliable technologies, unique formal language

1. Policy

With the growing environmental consciousness and seeing the adverse effects of climate change, the Government of India and the governments of various Indian states are supporting many initiatives for the development of eco-friendly technologies, which can reduce the carbon footprint emanating from India. Regulation has become one of the prime factors driving this change. Energy audits have been made mandatory in large consumer units from March 2007. An energy-labeling programme for appliances was launched in 2006 and comparative star-based labeling has also been introduced. Recent signing of the agreement in Copenhagen on Climate Change, India is committed to pursue this policy aggressively. Programme of 'Urban Renewal' of the Government of India insists on energy efficiency, and incentives in the form of cheaper loans are offered to urban transport authorities. The National Solar Mission would promote the use of solar energy for power generation and other applications. Even Indian industry has taken up these issues seriously. Energy efficiency has become the top most agenda for Indian companies as well. Big automobile companies are developing electric vehicle technologies and/or buying smaller electric vehicle companies to prepare for the future. One good example is that Mahindra & Mahindra recently bought Reva Electric car company from Bangalore.

Ecological Policy Initiatives

Changes in India
Prime Minister's Council on Climate Change
Government of India

National Action Plan
Eight National Missions form the core of the NAPCC, which represents a multi-pronged, long-term and integrated approach for achieving key goals in the context of climate change. These include:

- National Solar Mission
- National Mission for Enhanced Energy Efficiency
- National Mission on Sustainable Habitat
- National Mission for Sustaining the Himalayan Ecosystem
- National Mission for Green India
- National Mission for Sustainable Agriculture
- National Mission on Strategic Knowledge for Climate Change

Ecological Policy Initiatives

Global Changes

- The U.S. has pledged US\$2.4 billion in federal grants for electric cars and batteries.
- China has announced it will provide US\$15 billion to initiate an electric car industry.
- In the budget of 2011-2012, India has reduced the excise duty for electric vehicles from 12% to 5%. Stated like Delhi has given total exemption from Sales tax (VAT).
- Several national and local governments have established tax credits, subsidies, and other incentives to reduce the net purchase price of electric cars and other plug-ins.

Changes in India - Business Initiatives

Abhinav Mahindra Reva
The first mass produced electric car in India. It is a 2-seater, 4-wheeler, with a range of 150 km. It is powered by a 16.5 kWh battery pack. The car is designed to be a 'mini car' that can be used in urban areas. It is a 'plug-in' electric vehicle, which means it can be charged from a standard AC power outlet. The car is designed to be a 'mini car' that can be used in urban areas. It is a 'plug-in' electric vehicle, which means it can be charged from a standard AC power outlet.

Changes in India - Business Initiatives

Cars will be Smaller in the future?
Yes. The decrease in size would accompany lowering the price of cars, which would eventually lead the increased availability of personal vehicles.

2. The Challenge

Although first electricity driven car was driven in 1880s, it lost the race to gasoline-powered vehicles due to the deficiencies of range, weight and time of charging. Despite having made great strides in technology in more than hundred years, the electric vehicle suffers from same problems even now. What is however encouraging is that serious thought is being given to add value and make these vehicles viable 'somehow' and 'somewhere'. The rising cost of crude oil is helping this movement. Advantage of this movement is that it is throwing challenges to various technology disciplines, and the persons working in these areas are doing their best to find solutions and attracting research investment. With these inputs, it is bound to yield positive results in due course.

Changes in India - Business Initiatives

India - Business Initiatives
Commercial production of Tata's first electric car to start in Q3 of 2011.
Sudhakar Kamath
1-2010-11-12 01:51:00

The most heavily promoted electric car in India is the Tata Nano EV. It is a 2-seater, 4-wheeler, with a range of 150 km. It is powered by a 16.5 kWh battery pack. The car is designed to be a 'mini car' that can be used in urban areas. It is a 'plug-in' electric vehicle, which means it can be charged from a standard AC power outlet.

Will electric car reign in Indian roads?
By Rishi Prasad, Sr. Business Analyst, IDC
February 2011, 96 24 01

Although still in the nascent stage, the electric car market sees a bright future in the coming years. The car makers have realized that in an era of alternate fuels, this will most likely influence the future of the car. The cost of electric vehicles has dropped to a level that strong business model with great commercial potential that opens short range is good enough.

3. Strategy

As a strategy to make the electrical vehicles acceptable and usable, efforts can be made to design and orient the use of specialized electric vehicles to niche situations and markets, where these vehicles can have an edge over petrol driven conventional vehicles. This needs to be understood well. If the limitations of the electric driven vehicles is leveraged by design, special vehicles for special applications / special situations can become viable and common-place, thereby relieving the pressure on oil, environment (pollution), health & carbon footprint.

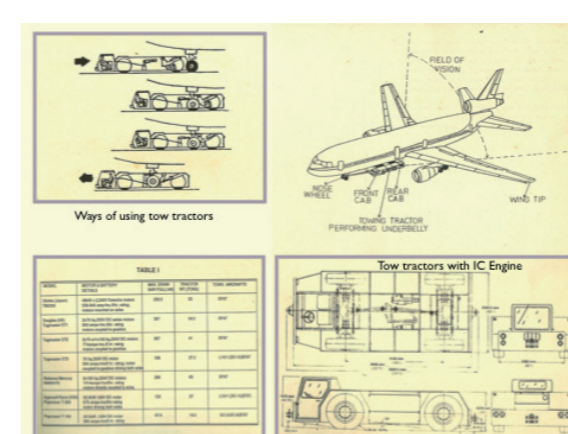
Potential Benefits for outweigh the limitations of the electric vehicles
Significant reduction of urban air pollution
Reduced greenhouse gas emissions
Reversing climate change
Less dependence on foreign oil
Less adverse impact on the balance of payments of poor countries
Less vulnerability to price shocks and supply disruption.

What is however encouraging is that serious thought is being given to add value and make these vehicles viable

STRATEGY
Potential Benefits, if leveraged and the limitations of the electric vehicle if turned into advantage by "design" special vehicles for special applications / special situations can become intrinsically viable.

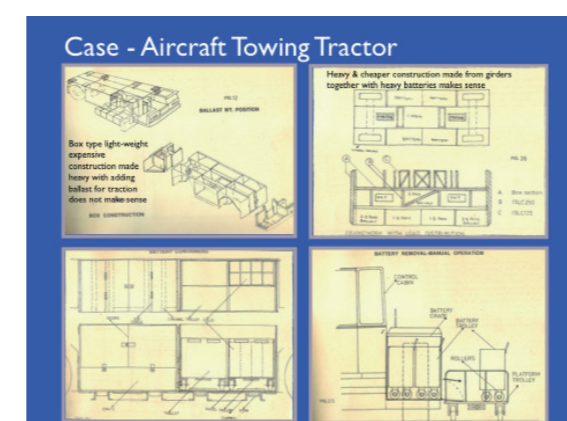
Design and orient the use of specialised electric vehicles to niche situations and markets

airport can lend itself very easily to vehicle electrification. It is now easy to think that all busses running in the airport for ferrying passengers to and from aircraft to the terminals could be electric vehicles. One can argue that aero-bridges obviate the need for such traffic. But then aero bridges in the context of developing countries like India are available only in a few large city airports. The rest are still dependent on gas guzzling, Carbon Dioxide fuming buses for ferrying millions of passengers across the airports all over the country. Although it seems so obvious that we should have 'electric ferry busses' on the airports, but I have not seen even one electric bus on any Indian airport, despite paying so much lip service to pollution and carbon footprint by government, media and civil society. Not only busses, but all the vehicle at the airports could be electricity driven, which can include aircraft tow tractor, baggage and food trolley towing tractors, maintenance runabouts, crew vehicles etc. It could be a small but a very important beginning.



4. Case 1

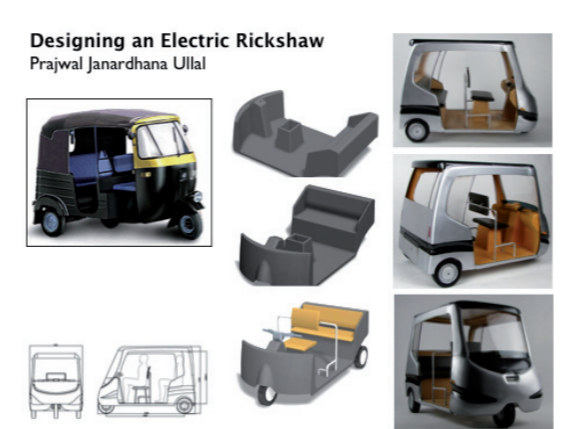
One case study was developed through a project for the 'design of electric aircraft tow tractor'. An aircraft tow tractor tows the aircraft from runways to the tarmac or apron, and back. Presently it is highly fuel guzzling and polluting vehicle, as it has to have weight (added through ballast) for traction to tow the heavy aircraft. Making it



electric, can offer many fold advantages, which will be elucidated in the case study presentation. The disadvantage of an electric vehicle is that it is heavy, which is a positive aspect for an aircraft tow tractor. Cheaper, heavier and dependable lead acid batteries can be used as their high weight can create an advantage. The airport is a confined space; hence the range of the vehicle need not be large. Intermittent usage (as it is not used all the time) of such vehicle can allow it to move to the charging stations more often to get charged. The structure of this vehicle need not be efficient and expensive (as in monocoque vehicles), but inefficient, heavy, rugged and less expensive. What we see here is that all the inherent disadvantages of an electric vehicle could be converted into advantage in this situation. Similar advantage can be created in varying degrees in industrial campuses, gated communities, small urban clusters and similarly identified situations, with vehicles for different usage and where short range is good enough.

5. Education & research

A new Masters and Doctoral level program was started from last year for education and research into 'mobility and vehicle design' issues at Industrial Design Centre, IIT Bombay, to create a body of specialist vehicle designers, who can address the problems of future mobility in the country, and also to develop the research culture in this discipline. Special emphasis is given to eco-friendly vehicle development and research. Light weighting is a very

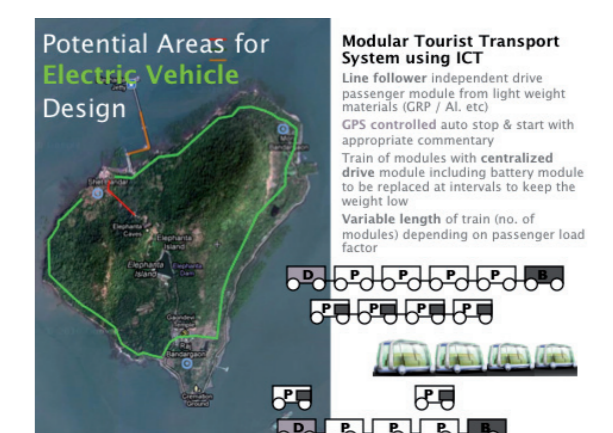
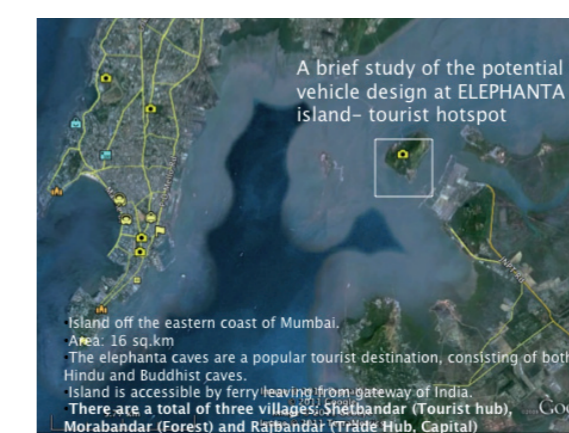


important criterion for electric vehicles, to make them run cheaper and longer. Initiatives to develop small electric vehicles are undertaken for situations like campuses, gated communities, industrial estates where heavier vehicle are not necessary for transport and smaller ones are adequate enough. Research is being conducted on light weighting of these vehicles to reduce the power consumption further. Integrated single unit reinforced plastic bodies for 2-wheelers and 3-wheelers are built and tested to achieve this objective. By designing 'single-seat mini electric scooter' and similar small vehicles, examples were created, and proto-

types were developed to prove the concepts. These concepts can be adopted and developed by 'research-shy' companies for manufacture and marketing.

6. Design Integration

Integrating computer and communication technologies with electric vehicle can become a big driver for development. One such example can be the development of autonomous road trains for small tourist destinations / archeological locales, which are sensitive to pollution from high traffic during the season. Pollution free transport seems to be an imperative need. A project is being undertaken at IIT Bombay to develop a mobility facility at Elephanta Island, a small tourist spot near Mumbai, for tourists who visit the ancient caves there. An autonomous mini road train running on battery bank charged through Solar panels and following a 'tour line' is being contemplated. Besides being a facility for tourists, it offers an additional means of livelihood to the local community who are dependent on tourism. It is to be showcased as a prototype for mobility solution in small towns particularly the tourist towns.



7. Water in Pot Model

Traditionally the form or physiognomy of a product is dictated by the size of the components, mechanical linkages and their physical interference or fit. The emerging technologies are fluid in character, and therefore physically pliable. There is very little or no physical constraint offered. Like water, usefulness of technology is dependent on the form of the container or 'pot' in which it is placed. For example, if water is to be drunk, it has to be kept in a glass or tumbler, and if it has to be poured, it is kept in a jug with spout; and if it has to be carried, the pot takes the shape of 'narrow mouthed' vessel, so that it does not spill and so on. Besides the use factor the 'pot' has cultural connotations. For example, a tea-cup is not suitable for drinking water, though it can be used. Modern technology, which is fluid, placed in suitable "container" performs better, if the shape of the "container" is designed to suit the situations. Human and contextual issues are the determining factors for design. Major design criteria therefore have to be psycho-physiological, cultural and environmental.

8. Unique Formal Language

Electric vehicles do not need the space for voluminous internal combustion engines or bulky gear trains. The prime-movers in electric cars are built into the wheels, the battery pack, particularly the newer polymer batteries are flexible and can be configured according to the availability of spaces and spread, and yet the electric vehicle simply looks like a sedan, or SUVs and even with 'air vents' in the front. The physiognomy of electric vehicles can be and should be quite different from what we see today in cars or hybrid vehicles. Industrial Designers and stylists are struggling hard to invent a new formal language, which depicts the uniqueness of this breed of products. We have had similar difficulties in the past, when cars were made like horse buggies, and first TVs were made to look like radios. With so much interest and so many people inspired to work in this area, discovery of a new



identity / aesthetic breakthroughs for electric vehicles are not far off, as new conceptual breakthroughs are invariably driven by the development of new technologies which I believe have fairly matured and moved to 'post failure' stage. The attempts in this direction are worth watching.

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