Electric Cars -
The ‘Green Answer’
to the Energy Crisis

Growing environmental consciousness and the adverse effects of climate change, are propelling governments to support initiatives towards the development of eco-friendly mobility solutions including electric vehicles. Efforts have to be made to orient the use of electric vehicles to niche situations and markets where their limitations can be leveraged by design.

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Increasing environmental consciousness and in view of the harmful effects of climate change, the Government of India and those of various Indian states are supporting various initiatives for the development of technologies, and reduction of 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, since March 2007. An energy labelling programme for appliances was launched in 2006 and comparative star-based labelling has also been introduced. With the recent signing of the agreement on Climate Change, in Copenhagen, India is committed to pursuing this policy aggressively. The Government of India’s programme on ‘Urban Renewal’ insists on energy efficiency, and incentives in the form of cheaper loans are being offered to urban transport authorities. The National Solar Mission is promoting the use of solar energy for power generation and other applications. 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. A good example is that of Mahindra and Mahindra (M&M) who purchased the Reva Electric Car
Company. Tata Motors has also initiated development of electric cars in various segments. They believe that the future belongs to smaller cars and have showcased their efforts at various motor shows around the world.

The Challenge

Although the first electricity driven car was driven in the 1880s, it lost the race to gasoline powered vehicles due to its deficiencies in range, weight and time of charging. Despite having made great strides in technology in the last 100 years, the electric vehicle still suffers from the same problems to date. 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 and the advantage is that it is posing challenges to various technology disciplines, and those working in these areas are doing their best to find solutions and attract research investment. With such inputs, it is bound to yield positive results in due course.

Strategy

Presently, on a global scale, effort is to build cars which can replace the existing petrol / diesel driven cars. However, this makes these cars very expensive and therefore unacceptable. It will take quite some time before these vehicles (hybrid or pure electric or hydrogen based) can compete on price with existing vehicles. As an immediate strategy to make electrical vehicles acceptable and usable, efforts may be made to design and orient the use of specialised electric vehicles to niche situations and markets, where these vehicles can have an intrinsic edge over conventional vehicles. This needs to be understood well. If the limitations of the electric driven vehicles are leveraged by design, then special vehicles for special applications / special situations can become viable and commonplace, thereby relieving the pressure on oil, environment (pollution), health and carbon footprint, to an extent.

The limitation of range if understood, can let us identify areas where the range of a vehicle is not important. One such example is the airport. Airports have become an essential infrastructure of a city, however small. Airports are highly, traffic and surface vehicle intensive and therefore one of the most polluted areas of a cityscape. If analysed, the airport can lend itself very easily to vehicle electrification. All buses running in the airport for ferrying passengers to and from the aircraft to the terminals could be electric vehicles. One can argue that aero-bridges obviate the need for such traffic. However, 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 airports, all over the country. Although it seems so obvious that we should have ‘electric ferry buses’ on the airports, but one is yet to see even one electric bus on any Indian airport. In fact to make
a small but very important beginning, not only buses, but all vehicles at the airports could be electricity driven, including aircraft tow tractor, baggage and food trolley towing tractors, maintenance runabouts, crew vehicles etc.

**Case Study**

A case study was developed through a project for the ‘design of electric aircraft tow tractor’ that tows the aircraft from runways to the tarmac or apron, and back. Presently it is a 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 manifold advantages, which will be elucidated in the following case study. 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 charging stations more often to get adequately 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 (Fig. 1) is that all the inherent disadvantages of an electric vehicle could be converted into advantages in this situation.

Similar advantages can be created in varying degrees in industrial campuses, gated communities, small urban clusters and similarly identified situations, with vehicles for different usages and where short ranges are fine.

**Education and Research**

A new masters and doctoral level programme was started from 2010 for education and research into ‘mobility and vehicle design’ at the Industrial Design Centre, Indian Institute of Technology (IIT), Mumbai; and to eventually create a body of specialist vehicle designers, who can address the problems of future mobility and develop research culture in this discipline.

Research is being conducted on making light weight vehicles so as to reduce power consumption further. Integrated single unit reinforced plastic bodies for 2 wheelers and 3 wheelers have been built and tested to achieve this objective. An electric scooter (Fig. 2), which

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**Electric Vehicle**

- Single unified Body design in FRP integrating
- Styling Ergonomics, Engineering
- No metal Chassis Light weight vibration & Fatigue resistance

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Design Integration

Integrating computer and communication technologies with electric vehicles can become a big driver for development. One such example is the development of autonomous road trains for small tourist destinations / archaeological locales, which are sensitive to pollution from high traffic. A project is being envisaged at IIT, Mumbai to develop a mobile 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 a 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 that is dependent on tourism. It can be showcased as a prototype for mobility solution in small towns particularly tourist towns.

Unique Form

Electric vehicles do not need the space as needed 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 an SUV and even comes 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 working 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 the first TVs were made to look like radios. Indeed with so much interest and so many people inspired to work in this area, the discovery of a new identity or an aesthetic breakthrough for electric vehicles is not a distant dream considering that new conceptual breakthroughs are being driven by the development of new technologies which have fairly matured and moved to the ‘post failure’ stage. The attempts in this direction are worth watching out for.

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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 fitness. Emerging technologies are fluid in character, and therefore physically pliable. Like water, the 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 a 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 ‘pot’ has cultural connotations. For example, a teacup is not suitable for drinking water, though it can be used. Modern technology too, like fluid, when placed in a 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.