Whither electric vehicles?

Electricity is the natural medium for the application of motive power. Its supply is unlimited. It is everywhere. It is to movement what the sun is to growth.

– *Western Electrician,* January 1889

In the late 1890s, at the dawn of the automobile era, steam, gasoline and electric vehicles all competed to become the dominant automobile technology. By the early 1900s, the battle was over and Internal Combustion Engine Vehicles (ICEVs) were poised to become the prime movers of the twentieth century.

At present, about 60 million ICEVs are manufactured every year worldwide and it is projected that there would be about one billion ICEVs on the earth's roads by 2002, i.e. one for every seven people. This upsurge in the use of ICEVs is causing considerable pollution problems in our urban conurbations. In response to the growing concerns over the urban air quality, the state of California enacted in 1994, a legislation requiring that by 1998, 2% of cars offered for sale be zero-emission, increasing to 5% by 2000 and ultimately 10% by 2003. These deadlines however have been amended, largely because of the failure of battery-powered vehicles, which were originally seen as a solution, to perform at a level approaching that of the existing ICEVs. However, pure battery-powered vehicles are no longer regarded as an acceptable alternative to ICEVs, except possibly as Neighbourhood Electric Vehicles (NEVs) which are designed to provide low-speed transportation in restricted areas such as university campuses, hospitals, airports, theme parks, industrial parks, holiday resorts, residential complexes and city centres.

The above situation does not imply that there are no legitimate uses of pure battery-powered electric cars today as fleet vehicles, as community cars and as second cars for families that already own a gasoline automobile for long-distance travel. One solution to this enigma might be to take the pure battery-powered electric cars out of the development laboratories and put them in the hands of the real drivers. Some will find these vehicles inadequate, but many others may not. With this proposition in mind, Saturn, in partnership with General Motors Advanced Technology Vehicles, now offers GEN II EV1 to consumers through a lease-only programme. Select Saturn retail facilities in California and Arizona distribute and service EV1. Saturn believes that this is the best way to ensure total customer enthusiasm for the early customers in their vehicle. Leasing will provide the customers with a known, consistent cost of ownership. Saturn covers all routine maintenance and service under the terms of 3-year/36000-miles new-vehicle limited warranty. This includes everything from batteries to tyres. Saturn also provides a 24-hour roadside assistance programme, to make every aspect of EV1 lease trouble-free.

While the fate of pure battery-powered electric cars hangs in limbo, the last five years has seen a dramatic development in fuel cells which have advanced to the point where manufacturers believe that the technology is commercially viable and capable of delivering sufficient energy for running the cars. Among various types of fuel cells, the low-operating temperature and rapid start-up characteristics, together with its robust solid-state construction give the Polymer Electrolyte Fuel Cells (PEFCs) a clear advantage for application in cars. The energy conversion efficiency of PEFCs is much higher than both Otto and Diesel versions of internal combustion engines.

The preferred fuel for PEFCs is hydrogen. Various strategies for providing hydrogen to PEFCs are presently being evaluated. Broadly speaking, these strategies could be divided into two categories: (a) to generate hydrogen on-board and on-demand from liquid hydrocarbon or methanol, and (b) to directly fuel hydrogen from a storage tank containing compressed/liquid hydrogen. Experts believe that for Fuel Cell Vehicles (FCVs) with an on-board fuel processor, it would be difficult to exceed the performance of the future ICEVs in terms of emission, efficiency, drivability, maintenance and first cost. By contrast, if the FCVs are powered by a directly-fuelled fuel cell, then there is every prospect that the performance of such vehicles will exceed that of the ICEVs, but not the first cost. However, given the recent rate of progress in PEFC technology, we expect a significant reduction in the cost of directly-fuelled fuel cells.

For direct-hydrogen FCVs, the main task is to develop a cost-effective, reliable and safe method of storing sufficient hydrogen on-board. Particularly, with buses, where there is more room for storage of hydrogen as a compressed gas, there are good prospects that commercial fuel-cell powered versions will be on the roads within 2 to 3 years. Such vehicles are centrally refuelled and therefore hydrogen-distribution infrastructure is not a critical issue.

Some car manufacturers undertaking the development of FCVs are Daimler–Chrysler who have a joint venture with Ballard, EXCELLSIS, Ecostar and Ford, General Motors with Opel, Honda, Mazda, Nissan, Renault, Toyota, Volkswagon and ZeTech. While some of these manufacturers are attempting to develop pure fuel-cell powered FCVs, others are attempting to develop vehicles either with a fuel cell–battery hybrid system or with a fuel cell–supercapacitor hybrid system. The problems that remain to be tackled are reduction in cost, weight and volume of fuel-cell systems, further improvements in driving dynamics, durability and reliability, development of cost-effective production technologies and installation of refuelling infrastructure for methanol and hydrogen. Although each of these problems represents a big challenge, FCV developers look committed to commercialize FCVs, and some of them as early as the middle of this decade.

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