

## Electric vehicles — are they a realistic option for the future?

M. Dunckley

*Hawker Energy Ltd., Stephenson Street, Newport, Gwent NP9 0XJ (UK)*

### Abstract

In the 1970s, as a result of rising oil prices and supply shortages, the concept of an 'electric vehicle programme' saw increased attention from legislative bodies, the automotive industry and general public groups. At that time, numerous 'experts' foresaw oil and fossil fuels running out early in the twenty-first century. As a result, a number of key issues came to the fore under the broad heading 'energy conservation'. A major part of this initiative was the need for a rethink of the automotive vehicle — the electric vehicle was considered a solution. In the event, the oil crisis of the 1970s came and went and the pressing debate for energy conservation and new vehicles went back into a more considered perspective. What emerged in the early 1980s was a new way of looking at automobiles. Cars were to become generally smaller and more fuel efficient. To add to the development of the car of the 1980s came a further new issue — the environment itself. The car became known as the single largest contributant to pollution. Increasing numbers of vehicles came to be seen as literally choking to death the planet earth. The next step in the story of the evolution of the vehicle was to control exhaust-gas emissions. One city, Los Angeles, even went so far as to legislate that by 1998, 2% of all new vehicles in the State must be 'zero gas' emitting. More North American states were to follow, to a point that every major car manufacturer in the world took note and has now embarked on a programme to develop a 'zero-gas' emitting vehicle. Today, the concept of an electric vehicle is back in focus. Throughout the world, the media are highlighting the electric vehicle as the next generation of transportation. The cynics argue that they have heard it all before, others believe that this time it could actually happen. For the battery industry, the implications could be enormous, and would change the industry as it is known worldwide. This paper discusses the options and likelihood of an electric vehicle programme going into mass manufacture, and its ramifications for the battery industry.

### Introduction

In the 1970s, as result of rising oil prices and supply shortages, the concept of an 'electric vehicle programme' saw increased attention from legislative bodies, the automotive and battery industries, as well as numerous public groups. At that time, many 'experts' foresaw oil and fossil fuels running out early in the twenty-first century. As a result, a number of key issues came to the forefront under the broad heading of energy conservation. At the centre of the debate was the issue of rethinking the shape and general concept of the automotive vehicle. One solution was an alternative to the combustion engine in the form of an electric vehicle.

In the event, the oil crisis of the 1970s came and went and the pressing debate for energy conservation and new vehicles returned to a more considered, less urgent,

perspective. What emerged in the early 1980s as result was a new generation of cars that were to be smaller and more fuel-efficient. The issue of an electrically-powered car seemed to almost fade away.

In the mid-to-late 1980s, the issue of the environment re-emerged. This time the concern was larger than the debate about diminishing fuel resources. A global debate was to rage worldwide about the condition of the planet itself, and particularly the damage that was being caused by pollution via the so-called 'greenhouse effect'. The largest cause of global pollution is thought to be carbon monoxide gas caused by burning fossil fuels, and the main contributor to this effect is the automotive vehicle. Once again, a debate began about reducing gas emissions and finding a new alternative to the combustion-engined vehicle.

In 1990, the City of Los Angeles was to make history by declaring an intention to reduce pollution. The action went further: it was legislated that, by 1998, 2% of all new cars sold throughout the State will emit no air pollution; 10% must be emission free by 2003. On current estimates, this means 200 000 vehicles in the State of California. Other States followed suit, including New York and Massachusetts. Today, ten other US States are considering similar initiatives.

In Europe, comparable schemes have emerged. Cities in Holland and Italy have also declared their intention to have so called 'emission-free' programmes. It is inevitable that others will follow.

### **The electric vehicle debate**

The current debate about electric vehicles is not new. The discussion has persisted to varying degrees since the beginning of the century. Of course, numerous groups have encouraged the debate, such as city planners, transportation groups, and certain 'interested' industries e.g., the battery manufacturers. Furthermore, electric vehicles are not a new concept; they have been around in one form or another for years and were in fact the forerunner of the combustion engine. For example, between 1900 and 1910 there were more electric cars than gasoline-driven units. It is interesting to reflect that at some point between those two dates, various groups of people must have asked whether the combustion engine was itself a realistic option for the future?

The human race has had a love affair with the automotive vehicle throughout this century. When history judges this era, it will look back at some of the dominant features and almost certainly will list the car. Why? The car in peoples' eyes has created a new age of freedom: an ability to move great distances in a relatively short span of time across both countries and continents. It has helped to expand our horizons and exchange ideas and culture with other people. It has enabled business to expand by providing a source of wealth from which many feeder industries have risen, and thrived. It is true to say that the car has been as large a part of the age of global communications as the telephone, television, aircraft, and the printed word.

As well as freedom, the car has also represented a symbol of status in Western culture. It is an easily recognized symbol of our self-perceived image of ourselves. It has been a way of stating our position in the social strata of society. The bigger and more expensive the car, as well as the faster it can travel, have together become a mark of our success. These features will have a significant influence on the decision-making processes that will be necessary for people to purchase a new form of vehicle.

## Factors at the centre of the debate

On the surface, the environmental issue is the largest contributant as to whether the electric vehicle may actually eventuate or not, this time around. There are, however, other factors.

Almost all of the world's major cities have now reached a point of overcongestion. As any car driver who travels in major cities will know, travelling time has continually increased over the years as the traffic population has escalated. This has happened despite continual improvements to route systems that have been made to carry more vehicles at higher speeds throughout the Western world. Despite these advances, the growth in car population has outstripped new investment in construction programmes.

As car populations have increased, so too have gas emissions. Airline travellers will be familiar with the yellow fogged haze that can be seen from the air and that clouds over major cities. In Tokyo, a highly polluted city, it is a common sight to see people walking or riding bicycles through the street with air filters over their faces. People now fear lung cancer and other respiratory-related diseases from automotive gas emissions as much as from passive smoking.

## The future of the electric car

In a study carried out by the Massachusetts Institute of Technology of the worldwide automotive industry and summarized in a now famous book called *'The machine that changed the world'*, a section commented on the future of the car and the implications for the automotive industry. The following extract clearly summarizes the present and future positions from an industry and user perspective.

'...the world automotive industry has lived during its first century in a benign environment – demand for its production has increased continually, even in the most developed countries; space has been available in most areas to expand road networks greatly; the earth's atmosphere has been able to tolerate ever-growing use of motor vehicles, with minor technical fixes in the 1970s and 1980s designed to solve smog problems in congested urban areas. Soon, the environment for operating motor vehicles may become much more demanding.

Demand for cars is now close to saturation in North America, Japan and the western half of Europe. A small amount of incremental growth will be possible in the 1990s, but by the end of the century producers in these markets will need to provide consumers with something new if they want to increase their sales volume.

...we would be surprised if the motor industry does not have to respond in dramatic ways – and its response may provide the final test of lean approaches to research and development. For example, in the extreme case, emissions of carbon dioxide might have to be eliminated altogether, creating the need for hydrogen-powered cars which produce only water as an end product of combustion, or even solar-powered vehicles... A much more difficult challenge (for the automotive industry) lies ahead.'

As that statement clearly shows, the automotive industry is at a crossroads with a dilemma of macro proportions in front of it. Market growth is slowing down and automotive manufacturers are being driven towards the development of more specialist vehicle markets to maintain their volumes. Where once there was a market for a single vehicle model, there now exists a highly complex range of configurations designed to meet varying demands from family use, leisure, business, sport, and so on. People no longer want just a car, but now want a car that can fulfil a specialist need. In

marketing parlance, this niche strategy for specialist vehicles has created a complex set of problems for technologists, designers, and manufacturing, procurement and sales specialists.

It is clear that leaving aside the issue of the power source, a niche for an alternate energy-driven vehicle could be created. What may not exist, certainly in the short term, is a major or large-volume market. Industry standards and the perceptual attitudes of people towards an electric vehicle will have to be also changed. It is clear, however, that small groups of people are willing to purchase a vehicle with an alternative power source. A market exists for urban driving.

### **The power source for an electric vehicle**

Having concluded that a market would exist for an electric vehicle, the key factor must be the source of power. A recent magazine article concluded that: 'Electric cars can go as fast and as far as those with internal combustion engines at the same cost — so long as the batteries are excluded from the calculation...once the batteries are borne in mind things look much less promising. The electric cars' speed and range is halved, and their cost soars.'

The automotive and battery industries are aware of these constraints and are now globally addressing the problem. Ideally, automotive manufacturers want a new source of power that is non-gas emitting. A battery power source in various forms could clearly do this job but with numerous limitations on vehicle speed and range. To overcome this, numerous research projects around the world are now working to create a technological quantum jump that will propel the car into the next century. The financial muscle of collective groups such as government, and supplier and manufacturing industries, including lead producers, automobile and battery manufacturers, are already contributing capital and people resources to seeking a solution. But it would be wrong to believe that such a quantum jump will come in the near future. It is more likely that a major new source of power will take some years and a more pragmatic answer to 'when' would be the end of the century and even beyond.

In the meantime, an interim solution will be necessary and will have to come from existing technologies. Car manufacturers around the world have accepted this compromised solution.

### **The role of government**

Like all new technologies, the electric car will not come cheaply either in forward investment or the final purchased product. Huge investment programmes have already been committed to a new type of vehicle and early indications of purchasing costs for such vehicles seem prohibitive unless government incentives are given. The Fiat Group have publicly stated that an electrically-powered version of the Cinquecento will be available this year powered by 350 kg of lead/acid batteries. The vehicle will cost around 26 million lira — roughly 2.6 times the cost of its petrol equivalent. It will have a maximum range of 70 km in urban driving conditions, travel at a top speed of 80 km/h and accommodate two adults. Fiat have also gone on to state that they see production rising from 150 to 200 vehicles in 1992–1993 to around 20 000 by 1998. They have also predicted that the Italian market alone will absorb 70 000 vehicles by the end of the century. If these numbers are projected, it can be seen

that Europe could be producing as many as 200 000 vehicles a year by the end of the century. The global scale is potentially enormous.

But what form is this vehicle likely to take? Fiat, like many others, view the electric vehicle as 'a little car, for the city only'. After a great deal of market research, they found that most people require a maximum range of 35 km a day. They also found that the average speed of traffic in a typical Italian city is just 12 to 15 km/h. These restrictions clearly indicate that, even within present technology constraints, an electric vehicle could do the job.

Governments and legislators will have to play their part. Fiat's leaders expect future governments to provide local tax exemptions and possible other fiscal incentives. Their goal is to bring the price to the same level as an equivalent conventional vehicle. They also believe that the market, certainly in the early stages, might pay a small premium of around 10 to 15%.

So what does all this point towards? Is the electric car a realistic option for the future? It is certainly true to say that an alternative car is the only option for the future. The key issue is gas emission. The automotive industry must develop a solution as well as find new markets. At this time, there appears to be no real alternative to a battery-driven solution. The problems are those of range, speed, life expectancy of the power source, and cost.

Worldwide, we are slowly driving to a polluted halt. The world is changing and perhaps even industrialization, as we know it, is changing. The issue of the future in many aspects of life may well be one of value and sustainability, rather than scale. This would mean that many people will have to re-evaluate their lives and seek new options. In the mind of today's automotive purchasers, the idea of a silently running, range-restricted vehicle that needs to be plugged into a mains source overnight might not send them dashing to the dealers. But as our lives change, we will all come to accept the fragility of our world and recognize that we too must play our part. A new form of transport, perhaps powered by a renewable power source such as a battery, that travels quietly and possibly less far may form part of that future.