Market Deployment of Hybrid and Electric Vehicles: Lessons Learned (New Annex)

1 Introduction

Annex VIII "Deployment strategies for hybrid, electric and alternative fuel vehicles" of this Implementing Agreement on hybrid and electric vehicles (IA-HEV) investigated promotion measures — run by governments and other public and private organizations — to enable the market deployment of clean vehicle technologies. By evaluating about 100 more or less successful promotion strategies, several general weaknesses could be identified and general recommendations have been formulated on how to avoid failures in promotion programmes. The study has been completed in 2002 and is publicly available from the interim Operating Agent of this new Annex. Contact details are mentioned in Section 6.

The Annex VIII evaluation study on deployment strategies did not focus on the clean vehicles themselves. Nevertheless, the evaluation made some definitions necessary concerning the vehicles, especially that of "marketable products." In the study, it has been stated that it is not enough to reduce "marketable" to the satisfactory functioning of the technology. In the highly competitive vehicle market "marketable" includes:

- Licensing, compliance with national technical standards,
- A purchasing process with reasonable conditions for the customers, including a reasonable purchase price,
- The reliability and safety of the technology,
- Easy access to fuels or other forms of required energy, in an area in line with the range of the vehicles,
- Service facilities within a reasonable distance,
- Trained staff at the service facilities,
- Availability of driving lessons (if necessary),
- Access to information on performance, operation and best application of the vehicles.

This list reflects the point of view of the marketing specialist who is focussing on the customers' benefits and the pressure on governments to promote the "right" product.

The current situation in the clean vehicle market can be characterized by the following elements:

- Hybrid vehicles are available on the market, and in several countries they are very successful.
- The fuel cell vehicle cannot be expected in the mass market before 2020.
- The battery electric vehicle is at the starting line of a renaissance, now that advanced battery technologies that provide a satisfying range and performance are becoming available on the market.

If one adds alternative fuel vehicles using e.g., natural gas, besides hybrid and electric vehicles, a manufacturer has several options for the choice of a clean propulsion technology. This situation calls for an evaluation of success factors at the level of vehicle technology and for an evaluation on the strategy of the vehicle manufacturers to put their products on the market. Therefore, the

IA-HEV has taken up the idea to establish a new Annex to address these issues. The new Annex will follow up on the work on deployment strategies in Annex VIII.

2 Objectives

This new Annex will analyze the "stories" behind introducing electric and hybrid vehicles on the market and it will draw conclusions for future clean vehicle deployment. The results will be interesting for government officials and private entities running promotion measures for clean vehicles, as well as for vehicle producers and their marketing specialists.

3 Working Method

When we look at the last 20 years of EV and HEV developments, we see a coming and going of new models, and behind each of these attempts to enter the market there was a story. Without any doubt all these individual stories follow patterns that can be identified. This identification of patterns is a pre-condition to learn from these stories and to avoid the repetition of mistakes. A first glance at the background and the effects in the market of all these coming and going vehicle models shows a very mixed picture (seeTable 1).

Nevertheless, some patterns can be distinguished:

1. Manufacturers start with huge optimism, but without sufficient financial backup, the cars are technically promising, but the production never exceeded a small number of pre-serial vehicles, the company disappeared. Examples are SAM by cree Switzerland and Hotzenblitz Germany.
2. Manufacturers start with great optimism, but without the necessary financial backup, the cars are technically reliable enough for pioneer customers but not necessarily for a mass market. Examples are TH!NK Norway/Ford USA, Solec France/Switzerland, and City-el Denmark/Germany. Some of these vehicles are still manufactured with low market success, but most of the manufacturers and vehicle makes disappeared.
3. Manufacturers have a good financial backup, the vehicles are technically good but the batteries fail, the production has never been started or has been stopped. Examples are BMW E1 Germany, Ford Ecostar USA, Audi Duo, and VW Golf CityStromer.
4. Manufacturers have a good financial backup, the vehicles and batteries are technically good but following an internal strategic decision manufacturing stops. Examples are: HONDA EV plus, GM Impact.
5. Manufacturers have a good financial backup, the vehicles and batteries are technically good but the customer did not buy them in satisfying numbers (too expensive?, range?, expectations?). Examples are EVs by PSA and Renault.
6. In special niches, the parameters do not count, the advantages in use are to the fore.

Table 1 Effect on the Market of Different Electric and Hybrid Vehicle Models

Financial basis	Technology	Batteries	Manufacturers hopes	Effect in the market		Examples	
				Effect	Remarks	Model	Sales figures
☹☹	☺😐☹	☺😐☹	☺☺	0	Only pre-series, did not enter the market	SAM by cree Hotzenblitz ….	
☹	☹	☹	☺☺☺	☹	Pioneer customers	Solec Pinguin TH!NK City-el ….	> 200 > 500 > 1,000 > 15,000
☺	☺	☹	☺😐	☹		BMW E1 Audi Duo Ford Ecostar VW CityStromer	prototype < 50 > 100 > 500
☺	☺	☺	☹	0	Manufacturer withdrew	Honda EV plus GM Impact	
☺	☺	😐	☺☺☺	😐		PSA Renault	
					Special niches	MicroVett Elcat TWIKE Milk carriages Car free resorts Electric 2-wheelers	

This is a not complete list of striking coincidences not going beyond the surface, but we notice some principal factors and a lot of open questions about their reasons and effects. Such a list of questions may include the following:

1. On which basis do companies decide on a clean vehicle technology they want to produce? (For example, Toyota decided to go into the development of a hybrid propulsion technology and stopped EV projects.)
2. Is the problem caused by dependence on components — for example, storage systems such as batteries and fuel cells — that are not produced by the vehicle manufacturer?
3. Is the problem caused by the fact that automotive engineers have fixed ideas about what a car has to be like? This is an assumption of Amory Lovins.

4. The other way round: are the ideas of engineers who are not automotive technicians (e.g., specialists in composite materials and lightweight design, electronics, and informatics) too early for the conservative car market?
5. How can cooperation between the traditional car industry and the great brands and innovative outsiders be initiated? This also weakens traditional hierarchies and demands more flexibility than usual.
6. Is the problem caused by too great promises by the manufacturers resulting in too high expectations that necessarily have lead to disappointments?
7. The most important question: financing and distribution channels.

Certainly also this list of questions gives only some indications and has to be completed.

GM Impact

GM decided to stop production.

Ford Ecostar

ABB NaS batteries began to burn in at least 2 cases during the recharging process. Ford stopped production after having sold about 110 vehicles.

MicroVett

Concentrates on special vehicle models for communal application, and by that constant sales figures and a good market success.

BMW E1

ZEBRA NaNiCl-batteries caught fire and destroyed the prototype.

Hotzenblitz

No financial backup, problems with Powercell ZnBr-Batteries.

Fig. 1 Examples of electric vehicles. (Photos supplied by Muntwyler Energietechnik AG.)

It is worthwhile to go into these questions. Answers can be found by interviewing the manufacturers, industry historians and technicians that have been involved in vehicle and battery technology development for decades. These answers can lead to a list of lessons learned that may be of great value for the renaissance of the electric vehicle as well as for future clean vehicle technologies like fuel cell vehicles.

Another source for learning lessons is the analysis of market studies that were made during the nineties of the previous century. They have been made on the basis of surveys by assuming fictive electric vehicles with certain features. Two examples are:

1. A study elaborated by the Freedonia Group, Cleveland, in 1993 that predicts 855'000 EVs in 2003.
2. A study of the Business Communication Company, Norwalk CT, in 1994 that predicts 1.1 million EVs only in the USA in 2004.

Of course these studies on market prospects have been made in view of the Californian Zero Emission Vehicle mandate that finally did not come into force as intended. Therefore the assumptions about the vehicle features that served as the basis for these studies are more interesting than the predicted EV numbers. In addition to those market predictions -that have been elaborated above all for investment funds or private investors- several studies tried to assess scenarios about the vehicle features. One of them, as an example, was elaborated by the New York Energy Research and Development Authority in 1994. The results of this study are shown in Table 2.

Such scenarios help to identify the progress made within the last decade, or show too high expectations (see the column "charging time" in Table 2!). This discrepancy may also reveal the boundaries of a technology or, the other way around, the underestimation of technical potentials.

It is quite probable that there are other sources that help to identify the 'internal' barriers of a vehicle technology and wrong estimations of vehicle producers, in view of the market deployment of their products. Market deployment is complex, many factors are playing a role, and it is difficult to understand their interdependency. Real stories as well as outdated assessments help to understand these mechanisms.

4 Status

This new Annex is still in a planning phase. The ideas outlined above will be presented at the next Executive Committee Meeting of the IEA Implementing Agreement on hybrid and electric vehicles (IA-HEV) in spring 2006. Then the member countries will decide on modifications, participation and realization of this Annex.

5 Outlook

In case the IA-HEV Executive Committee agrees to start this Annex, a workshop will be organized in autumn 2006 to elaborate the work plan and the financial background. Every expert that is interested in the mechanisms of success and failure in clean vehicle markets is invited to add ideas and comments -even before the autumn workshop- so that they can be included in the work plan. Results of the kick-off workshop and the invitation to join this new Annex as a country expert will be published in the IA-HEV Newsletter.

Table 2 Scenarios For Electric Vehicles, According to a Study by the New York Energy Research and Development Authority in 1994

Scenario	Range in kms (miles)	Price US$	Operation costs US$/mile	Charging time 100% at 220VAC	Performance (cold weather conditions)
Probable					
1998	96.5 (60)	38,500	0.58	4 h	sufficient *)
2000	96.5 (60)	37,000	0.56	4 h	sufficient
2002	128.7 (80)	27,000	0.43	3 h	sufficient
2004	128.7 (80)	26,600	0.41	3 h	sufficient
Possible					
1998	145 (90)	23,875	0.36	3 h	sufficient
2000	160 (100)	21,700	0.33	2 h	sufficient
2002	177 (110)	17,000	0.27	2 h	good *)
2004	193 (120)	15,500	0.24	2 h	good
Optimistic					
1998	193 (120)	15,750	0.24	90 min	good
2000	240 (150)	14,700	0.22	60 min	good
2002	290 (180)	12,550	0.20	60 min	good
2004	322 (200)	11,900	0.18	30 min	good

*) sufficient= 4-9 failure days/year in New York
good= less than 3 failure days/year in New York

6 How to Join

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