

A comparison of distribution of energy between Fuel Cell Electrical Vehicles and Battery Electrical Vehicles in Europe

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In the current framework of prohibition of motor vehicles using fossil fuels taken by several main cities in Europe, the question arises of the development of the infrastructures of distribution of alternative energies, namely the hydrogen (with Fuel Cell Electrical vehicles) and electricity (with Battery Electrical Vehicles). We first compare the main advantages/constraints of the two alternative propulsion modes. Then we review the existing studies on the deployment of a new distribution network for two important countries, France and Germany. Finally, we give some conclusions.

Keyword. HE-hydrogen distribution-Oral

INTRODUCTION

Since the diesel scandal, public authorities of several main cities have decided to progressively eliminate the diesel and gasoline cars from the heart of the cities. For example, the municipality of Paris has the objective to eliminate diesel cars in 2024 and gasoline cars in 2030. In this context, two alternative propulsion mode are the following:

- The electric car using hydrogen energy via a Fuel Cell motor (FCEV for Fuel Cell Electrical Vehicles);
- The electric car using electricity with Battery (BEV for Battery Electrical Vehicles).

We will first summarize the *advantages* and *constraints* of the two propulsion modes with the following criteria: the autonomy of the vehicle, the refueling time, the purchasing cost and the carbon emissions.

We shall then compare the cost of the new distribution infrastructures for two countries having a different energy mix:

- Germany, where most of the electricity surplus will come from green energy (solar cell, wind);
- France, where most of the electrical surplus will come from nuclear plants.

Then we give some ideas for new research directions and finally, we give the main conclusions.

ADVANTAGES/CONSTRAINTS OF THE TWO CAR PROPULSION MODES.

Clearly, the advantages of hydrogen cars are, on one side, the *time of reloading* (3 to 5 minutes) and the *autonomy of the car* (up to 600 km), against hours for loading a BEV

at home and 200 km of autonomy in real traffic conditions. The major obstacles of hydrogen cars are the cost and the reduced number of refueling stations.

RESULTS AND DISCUSSION

For Germany, the comparison of the cost of the two alternatives (BEV and FCEV) gives the following result: for low market penetration levels of a few hundred thousand vehicles, the costs of infrastructure are essentially the same. Hydrogen is then more expensive during the transition period to electricity-based generation via electrolysis and geological storage, which are both needed to access renewable hydrogen from surplus electricity. If hydrogen penetration increases up to 20 million vehicles, a battery charging infrastructure would cost more than the hydrogen infrastructure.

CONCLUSION

The two alternative modes will certainly be used in the future to take advantage of the unavoidable surplus electricity that characterizes renewable dominated energy systems. A complementary combination of the electric charging and the hydrogen refueling infrastructure will give a key to a green transportation system. The battery electric vehicles will be used for *short distance travel* and the hydrogen technology will be used for *long distance* and *heavy-duty transport* by fuel cell electric vehicle. Both infrastructures will also give the advantage of using lost green energy produced in surplus by the solar cell and wind turbines.

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