Project proposal — Fabricator of an pure electric hybrid vehicle

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***Abstract*—This document identifies the requirements for fabricating an electric car at FIME, UAdeC. Also, proposes a possible methodology to realize the project.**

I. Objective

The objective of this project is to model, design and fabricate an pure electric hybrid vehicle with the following functionality.

- Steep acceleration curves similar to the petroleum vehicles (PV).
- Maximizing the energy harvesting at all the times, i.e. during all kinds of the breaking routine.

II. Introduction

The electric vehicles were introduced in the early nineteenth century; these were holding a greater market in comparison to the internal combustion (IC) ones until the end of that century [1]. However, petroleum vehicles (PV) soon became more common on the roads later, which can be seen from the 2005 estimates, which indicate that the PV constitute a 97% of the vehicles [2]. Recently there is a growing interest in the hybrid vehicles (a hybrid of petroleum and electric) and pure electric vehicles (PEV) [3]–[5].

III. Selection of storage type

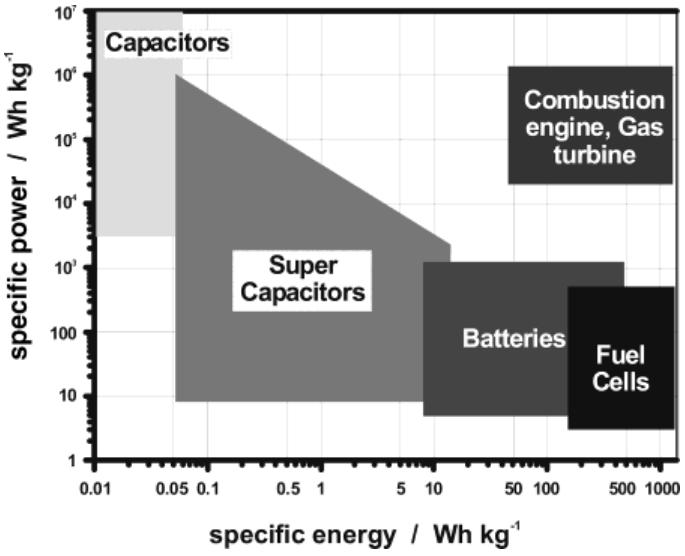

Figure 1. Ragone plot — Comparison energy density (specific energy) and power density (specific power) of most common storage domains [6].

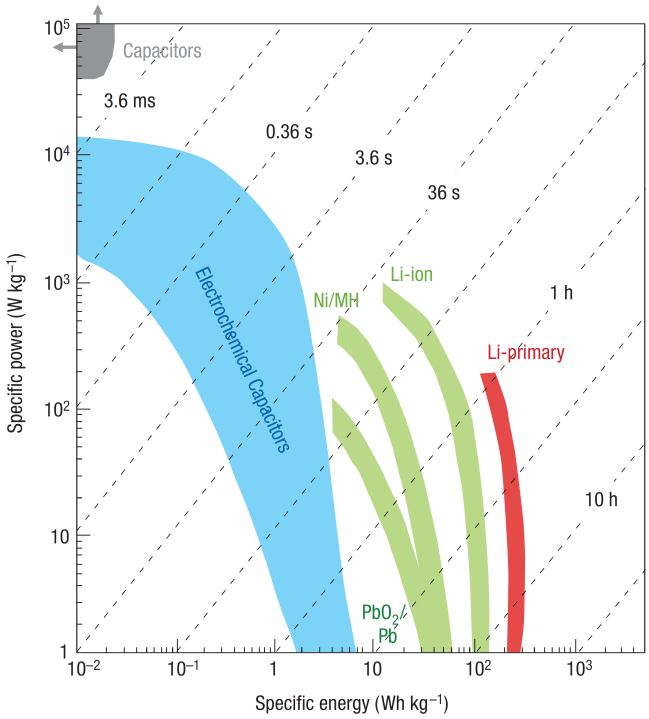

Figure 2. Ragone plot — Comparison energy density (specific energy) and power density (specific power) of various electric power storages [7].

Figure 1 shows the Ragone plot for the most common storage domains [7]. It is clear that combustion engines have high specific power and specific energy. In the context of automobiles, specific energy can be associated to the fuel autonomy measure, i.e. the distance it can move by consuming a unit fuel mass, and the specific power can be associated to the acceleration which it can achieve with a given unit fuel mass. So from Figure 1, we see that a petroleum based automobile have an advantage over any other domain. Also, we can see that a properly designed electric hybrid system can perform on par with combustion engines.

Figure 2 shows the Ragone plot of electric storage devices. We can ignore the Li-primary batteries option because they are not rechargeable. So, the solution to achieve high specific energy and specific power is combining the positive trades of the supercapacitors (electrochemical capacitors) and the Li-ion batteries in an hybrid system.

IV. System design

At any given time a vehicle operates in one of the two modes, namely the driving mode and the braking mode. In an EV the

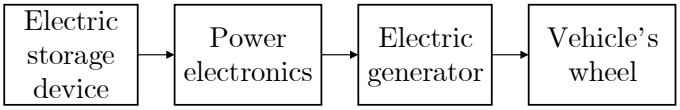

Figure 3. Power flow diagram of an EV in the driving mode

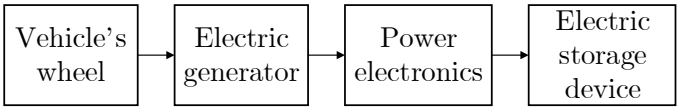

Figure 4. Power flow diagram of an EV in the braking mode

wheel is coupled to the electric machine. Hence, in the driving mode the electric machine should act as a motor and in the driving mode it should act as a generator. Figure 3 and Figure 4 show the power flow diagram for an electric vehicle in the driving mode and the braking mode respectively.

Figure 5 shows a possible way of merging both modes of operations in a vehicle. In order to achieve this scheme, we need to satisfy the following conditions.

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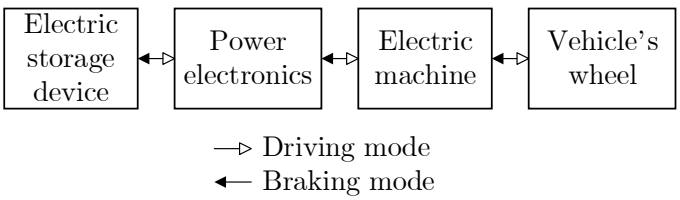

Figure 5. Schematic showing the EV's power flow diagram