Evaluation of cost and benefit due to alternative vehicles:
the Hydrogen Fuel Cells Option

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Session Tracks: **New technologies in Transportation, Technology and Energy Efficiency, Environmental Issues**

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In our time, a major effort is made worldwide to develop a marketable safety and sustainable vehicle option. All major car companies are involved as well as some energy majors. The Fuel Cells Hydrogen Vehicles (FCHVs) is an option that could be an answer to that need. This paper start to investigate on energy and environmental performances of this option and focusing on the infrastructures needed to make the FCVs a realistic alternative to traditional vehicles.

The first part of the paper will describe the major vehicle technology options already tested. This will allow making evidence of costs and benefits each option presents in order to justify the choice to concentrate our interest on specific technologies.
The second part focus on the scenarios concerning the hydrogen technology diffusion for Light Duty Vehicles (LDVs) calibrated for the Metropolitan Area of Boston. The scope of this chapter is to analyze the critical issues concerning the hydrogen supply infrastructure related to a possible diffusion of LDVs powered by hydrogen fuel cells, according to three different scenarios:

- The ***Business As Usual Scenario (BAU)*** depicts a market where no hydrogen vehicles are considered, and a very modest penetration of high efficiency hybrid LDVs will be introduced. Energy consumption related to this scenario need to be determined.

  This will be possible with the DOE/EIA National Energy Modeling System (NEMS) used to generate the projections in the *Annual Energy Outlook.* Although the NEMS calculations are limited to the year 2020, the time horizon we have chosen refers to year 2030. A first proxy for the projection to year 2030 apply an average growth rate in energy consumption obtained by looking at the last 10 year.

- The second scenario, named, ***Climate Policy Scenario (CPS*)** have an high penetration of high efficiency hybrid LDVs, approaching a large fraction (100%) by year 2030 of new vehicles sold in the market.
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- The third scenario, the ***Hydrogen Scenario (H2S)*** will be a perturbation of the second scenario: a large but plausibly aggressive fraction of hybrid LDVs will be replaced by Hydrogen FCVs. In the hydrogen scenario, to allow for the assessment of both the dimension and the characteristics of the hydrogen infrastructures needed, we first need to build up different evolution scenarios for the LDVs stock.

  The Tellus LEAP model will supply forecast for the H_2 FCVs LDVs stock from year 2010 to year 2030. According to the data obtained, calculation on the hydrogen demand will be performed by taking into account the unit consumption and the miles travelled per year by the vehicles considered.

The third par will describes and analyze costs related to the infrastructure needed to make the FCHVs a sustainable path towards a cleaner way to move. In particular, the following aspects will be treated:

- Hydrogen production alternative
- Ways to supply/produce hydrogen locally (refuelling station) or regionally
- Alternatives in terms of various hydrogen storage and power plant selections (Electrolysis case)
- Data on costs (cover both capital and operating)