Fuel Cell Vehicles are Close to Commercialization and it's Time to Think Hydrogen Fuel Cell Powertrain as Power Plant. Consideration about Germany, UK and Italy in EU Context.

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ABSTRACT

Overview

Worldwide in 2013 cars and LCVs production reached the highest level of 87.2 million and, according to Scientific American, major automakers suggest that cars powered by hydrogen fuel cells will finally hit the road this year. In the same time, most recent and authoritative reports still consider hydrogen fuel cell as a long term technology option (IPCC, AR5 WGIII) or choose to not include in the analysis (IEA, ETP 2014).

The Vehicle-to-Grid (V2G) concept is well known but it is possible to consider the Fuel Cell Vehicles (FCVs) power generation system hydrogen fuel cell based not only in V2G perspective but as a power generation plant, smart grid connected. In recent years I published different studies where I compared the Hydrogen Fuel Cell Powertrain (H_2FC Powertrain) Levelized Costs of Generating Electricity (LCOE), based on the U.S. public data, with the traditional power generation technologies LCOE with very promising results. In this paper I focused the analysis in three countries: Germany, UK and Italy, considered in the EU context.

If we will be able to well explain the results of this study to the policymaker of these European countries the possibility that a H_2FC Powertrain may be advantageously considered also as a power plant, maybe they will be able to support the introduction of these applications with relevant ecological, economic, strategic and competitive advantages in a Post Kyoto perspective.

Methods

LCOE is often cited as a handy tool for the analysis of generation costs and to compare the unit costs and the overall competiveness of different generating technologies. Focus of estimated average LCOE is the entire operating life of the power plants for a given technology. In LCOE model, different cost components are taken into account: capital costs, fuel costs, operations and maintenance costs (O&M), decommissioning costs. The resultant LCOE values, one for each generation option, are the main driver for choice technology.

Today Fuel Cells are present in a wide range of prototype and products. In my analyses I chose to consider the H_2FC Powertrain, PEM Fuel Cell based, as "Power Generation Plant" because, if the current U.S. Hydrogen and Fuel Cell Vehicle Program, as defined by the Energy Policy Act of 2005, is able to meet all technological targets, the high volume associated with the FCVs mass production will permit to reduce dramatically the Fuel Cell system manufacturing costs, in order to be competitive with gasoline in hybrid-electric vehicles (HEVs). In fact, in a mass production perspective, H_2FC Powertrain will be so cost competitive to be useful adopted also for stationary power generation application.

With regard to hydrogen infrastructure and FCVs commercialization in **EU,** the EC directive proposal recently adopted by the EU Parliament *on the deployment of alternative fuels infrastructure* paves the way to the realization of an European H_2 filling stations network. In **Germany,** the *National Innovation Programme on Hydrogen and Fuel Cells* (NIP) started in 2006 and, from 2009, the *H_2 Mobility* initiative implemented an action plan to build-up the hydrogen infrastructure with the aim to support FCVs commercialization from 2015 onwards and mass-production from 2017. In **United Kingdom**, from Jan. 2012, the *UKH_2Mobility* program brings together Government Departments and industrial participants. The group is actively working to develop a business case for the roll-out of FCVs, and the associated hydrogen refueling infrastructure, from 2015. In **Italy** there is not yet any initiative in this regards.

In this paper, using the U.S. DOE new data, that (considering the highly platinum cost) revisited marginally fuel cell historic data and ri-defined the targets timeline, I calculated the H_2FC Powertrain specific LCOE cost range and I compared with the generation costs of the traditional power generation technologies (EIA 2014 data). Then, the U.S. H_2FC Powertrain LCOE data are compared with most recent and authoritative German, UK and Italian LCOE data sources.

Results

Using the U.S. DOE current H_2FC Powertrain new data (referred to high projected production volume) I found that the LCOE would be USD 177 for MWh. Using the U.S. DOE new data target the H_2FC Powertrain cost range moves to USD 109-209 for MWh and, for the lower value of this range, it appears competitive with many of the U.S. power generation technologies analyzed.

Using a cross rate of 1.36 USD for EUR (and 1.2 LGS for EUR), these U.S. data in EU are: LCOE of 130 EUR/MWh today, and a range of 80-153.5 in 2020; Overnight cost of EUR/kW 40.4 today, and 29.4 in 2020.

Assuming the current U.S. H_2FC Powertrain high projected production volume data we found that, in the German, UK and Italian context, it appears competitive some of current renewable technologies LCOE data. In perspective, the H_2FC Powertrain technology, for the lower value of the target range, it appears comparable with many of the power generation technologies. In particular, in UK, the H_2FC Powertrain LCOE is lowest in comparison with all the other technologies LCOE average data (excluding *energy from waste*, *anaerobic digestion* and *geothermal*), for project starting both in 2013 and 2019.

So, H_2FC Powertrain seems to be useful to be adopted also for stationary power generation application.

Conclusions

If the current U.S. Hydrogen and FCVs Program is able to meet all the technological targets the high volume associated with the FCVs mass production will permit to reduce dramatically the Fuel Cell system manufacturing costs, in order to be competitive with gasoline in hybrid-electric vehicles. In a mass production perspective, that seem will start around 2017, H_2FC Powertrain will be so cost competitive to be useful adopted also for stationary power generation application, smart grid connected, because investments cost and LCOE will be competitive with the other power generation technologies.

Observing the results of this paper it seem to be necessary to start to think and debate the FCVs relevant link to the energy sector considering the possibility to utilize H_2FC Powertrain as a Power Generation Plant.

This possibility may have positive consequences for a rapid development of this break-through low-carbon technology with relevant ecological, economic, strategic and competitive advantages, in a Post Kyoto perspective.

Finally, considering the recent American, UK and German public-private initiative promoted in the transport sector, I suggest to consider the opportunity to organize also in Italy a similar initiative. Maybe: *Italy H_2 Mobility*.

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