How much CO2 would Electric Vehicles emit in Italy? providing a valid answer to a wrong question through a pivotal approach

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Research question

Electric vehicles are often perceived by the policy maker and the general public as an interesting way to reduce transport emissions. To support this view many scientists have produced estimates based on proxy variables like the average emissions of current energy generation, or, in the best situation, by referring to the short term marginal technology. These results are routinely used in the public debate and the scientific discussion in order to evaluate the benefits of EV diffusion. This practice however raises serious doubts.

On the first hand, it does not consider the existence of a cap and trade system on the emission of the energy sector. This system makes emissions unresponsive to the additional demand that derive from new electricity consuming products that are introduced in the market. Rather, such introduction has the effect of displacing the use of energy in favor of these technologies and to exclude others, socially wanted, uses of electricity.

On this other hand, assuming that the notion of ev emissions would make sense, estimates based on average or, to a lesser extent, peak marginal emissions can be misleading. This relate to the fact that EV consumption have a specific time pattern and activate various technologies based on the time of day distribution. In the short run, when generation facilities are given, electricity consumed in a certain time slot corresponds to various generation technologies. In the long run, the transformation of the merit curve represents how additional facilities are deployed to respond to an increase of electricity consumption. Thus it incorporates the long term response of the energy system to a change in demand.

Methodology

Based on this view, and focusing on the situation of Italy, we can use the pivotal approach proposed by Weinmann and Massiani and previously applied to Italy. This approach is based on the projection of the various energy facilities in the medium long run. This information coupled with the daily profile of consumption, indicates which technology is activated to reply to a, possibly additional, demand in a given hour. This calculation can be replicated for a sufficient number of daily consumption profile, and for a sufficient number of realizations of the, stochastic by nature, renewable energy generation.

Main results and references

Our results indicate, at this stage, that EV consumption is mainly generated by natural gas. This technology will increase its share in the future. ON the contrary, the increase of renewable will not make EV more beneficial. The main reason is that renewables will benefit priority compared to other technologies (to put it simply you don't start a gas generated turbine, until you have some "free" solar or wind energy available to serve the demand) and so will be already committed to serve the background demand. Thus the additional demand corresponding to EV will be served by fossil fuel based electricity.

Venezia, 29 aprile 2015