Renewable Energy Incentives and CO2 abatement in Italy

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Overview

This paper focuses on renewable energy source (RES) as instruments to reduce GHG emissions in Italy. To combat global warming, Italy has committed to clear environmental goals by cutting its CO2 emissions. To do so, it has notably encouraged renewable energy (RE) development. A variety of renewable energy incentives (REI) have been put in place such as different types of feed-in premium, green certificate, feed-in tariff, which have been revised many times along the years (GSE, 2011). These prompted a surge in installed capacity and generation of renewable energy in recent years, especially in wind and solar photovoltaic (PV) technologies. Wind capacity grew almost twenty-fold in 10 years (from 363 MW in 2000 to 6.9 GW in 2011). The growth of PV capacity was also more striking. The PV capacity has increased by 147 times in 5 years (from 87 MW in 2007 to 12.7 GW in 2011).

Marcantonini and Ellerman (2014) evaluated the cost of reducing CO2 emissions in the power sector for the past years through the deployment of wind and solar energy due REI in Germany. In this paper we extend the analysis of Marcantonini and Ellerman (2014) to Italy. The purpose is twofold. The first is to conduct an ex-post analysis of the Italian renewable policy in these last years for solar and wind energy in order to estimate how much it cost to abate carbon emissions through displacing conventional generation by RE. The second is to compare these costs with those for Germany and to analize whether there are major inter-country differences between the two countries and if so why.

Methods

We estimate the *carbon surcharge* and the *implicit carbon price* associated with the REI for wind and solar PV energy for the yeas 2008-2011 as defined in Marcantonini and Ellerman (2014). The *carbon surcharge* measures the cost paid to reduce the CO2 emissions in the power in addition to the carbon price resulting from the EU Emission Treading Scheme (ETS). It is given by the ratio of the *net cost* of the renewable energy over the *CO2 emission reductions* resulting form the injection of renewable energy in the power sector. The *implicit carbon* price is given by the *carbon surcharge* plus the average EU ETS carbon price paid by conventional generators. It gives an estimation of the CO2 abatement cost associated to the REI.

The *net cost* is the sum of the costs and cost savings due to the injections into the electric power system. The costs include the *equalized remuneration* and the *additional balancing cost*. The *equalized remuneration* represents the annual remunerations given to wind and solar energy producers calculated by equalizing in annual terms the sum of all the remunerations made along the life-time of the power plants (which we assume is 25 years both for wind and solar energy). It accounts for the direct cost of the REI, given that the remuneration to RE depends on the level on incentives. The *balancing cost* is the increase of costs in the managing of power system due to the intermittency of wind and solar energy. The benefits include the *fuel cost saving*, the *carbon cost saving* and the *capacity savings*, all related to the reduction of energy generated from conventional capacity due to the injection of renewable energy. Other benefits not directly associated with the generation system – such as energy security, innovation, green jobs, etc.- are not included. *CO2 emission reductions*, *fuel cost savings* and *carbons cost savings* are estimated using the ELFO++ model that is unit commitment model of the Italian power system (REF-E, 2012). They are calculated as the difference between the total CO2 emissions, total fuel cost and total carbon cost in the observable scenario, which corresponds to the historical scenario, and the *No Wind* and *No Solar* scenarios. *No Wind* and *No Solar* scenarios are the counterfactual scenarios where we suppose that no energy has been produced by wind and solar technology respectively.

Results

The *carbon surcharge* for wind energy on average equals 150€ per tonne of CO2 (tCO2) between 2008 and 2011, while the *implicit carbon price* is 164€/tCO2. The *carbon surcharge* and *implicit carbon price* for solar energy are higher than for wind energy, at 1005€/tCO2 and 1018€/tCO2 on average. The *implicit carbon prices* for wind and for solar are close to the *carbon surcharge* as a result of the low values of the carbon cost saving due to the low EU ETS carbon price in the analyzed period. This is because the average EU ETS carbon price in the period 2008-2011 was relatively low, the average value was 13.4€/tCO2. The large difference between the results of wind and solar energy is due to the *net cost*. For both wind and solar, the *net costs* are mostly determined by the *equalized remuneration*, the largest cost, and the *fuel cost saving*, the largest savings. The other costs and savings are small, if not negligible, with respect to these two. If we compare the *fuel cost saving*, *CO2 emission reduction* and *equalized remuneration* of wind and solar per MWh of energy generated, *fuel cost saving* and *CO2 emission reduction* of wind and solar are comparable as both technologies displace energy produced by gas-fired power plants. Instead the *equalized remunerations* of solar are much higher then those of wind making the *net costs* of solar greater than those of wind. This is because the incentive scheme for PV are much more generous than for wind. If we compare the *implicit carbon prices* with the historical annual average EU ETS carbon price, they are both much higher than the historical EUA prices, especially for solar energy. Moreover, they are also much higher than any realistic prediction about the EUA prices in the next years.

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Marcantonini and Ellerman (2014) evaluated the *carbon surcharge* and *implicit carbon price* from 2006 to 2010 in Germany. They found that the *carbon surcharge* and *implicit carbon price* are equal, in average, to 45€/tCO2 and 57€/tCO2 for wind energy and to 537€/tCO2 and 552€/tCO2 for solar. Thus the cost of reducing CO2 emissions in the power sector through the deployment of wind and solar energy in Italy have been much higher than in Germany, about twice higher both for wind and solar. This is due to the higher *net cost* and lower *CO2 emission reduction* of RE in Italy. The higher net cost is explained by the higher level of remuneration given to the RE producer in Italy with respect to Germany because of the higher level of the Italian REI. The lower CO2 emission reduction is linked to the differences in power generation between the two countries. The Italian electricity production is dominated by gas while in Germany by coal. Hence in Italy RE displaces mostly gas while in Germany both gas and coal. Given that coal emits more CO2 than gas per MWh of electricity produced, the CO2 emission reduction per MWh of RE energy generated is much lower in Italy with respect to Germany.

Conclusions

This paper suggests that if we look at the Italian REI as a policy to abate CO2 emissions, supporting wind and solar energy through incentives in the years 2008-2011 was a very expensive way to reduce CO2 emissions in the power sector, especially for solar. Moreover, it shows that the cost of reducing CO2 emission in the power sector by displacing conventional generation with renewable generation can be very different from country to country in Europe as it strongly depends on the national RE policy and on the structure of the existing national power sector.

References

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