

Subject number 7: PV - A MAJOR ELECTRICITY SOURCE

Subsection 7.1 PV in the electricity markets

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QUANTITATIVE ANALYSIS OF THE MERIT ORDER EFFECT FROM PHOTOVOLTAIC PRODUCTION IN KEY EUROPEAN COUNTRIES AND EFFECT OF MARKET COUPLING

A QUANTITATIVE ANALYSIS OF PV IMPACT ON THE ELECTRICITY MARKET IN SPAIN, FRANCE, ITALY AND GERMANY

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ABSTRACT: This study builds on a 2013 paper from M. Gourvitch, M. Gouzerh, M. Carton and M. Masson on "*Quantitative analysis of the merit order effect from photovoltaic production in ITALY*". It proposes to use the method developed in that paper to quantify the savings incurred by the end consumers in s over the past 7 years as a result of the decrease in electricity spot market prices observed when PV plants feed electricity into the grid. The 2013 study showed that the total electricity demand retreated by PV production is well correlated to market prices in Italy, following a stable exponential curve. Estimating such curve enables to calculate what the additional energy payments would have been had there been no PV production. Such gain, called merit order effect, has varied over time. This study will research whether the same effect can be seen in other European countries: France, Germany and the Iberian Peninsula. Italian results will be extended to 2013.

The authors have run Monte Carlo simulations on a large number of irradiation profiles and showed that the merit order effect does not depend much on the PV penetration rate but rather on the electricity demand profile in Italy, and therefore on how well it correlates with the PV production profile. The social gain expressed per MWh of PV electricity fed into the grid exceeds 100 €/MWh, and has exceeded € 2 Bn at the country scale in 2012. This study will apply the same methodology again to France, Germany and the Iberian Peninsula.

Finally the effect of market coupling on the merit order effect will be tested, using the European ELIX index and comparing the effects on the French and German markets.

Keywords: economic analysis, photovoltaic production, electricity prices, merit order effect, energy mix.

SUMMARY:

Part 1: Extension of the quantitative analysis of the merit order of PV to several European countries: France, Germany, Spain and upgrade for Italy until 2013.

The first part of the study will concentrate on a country quantitative analysis of the impact of PV. In particular the study would like to prove that for all the countries considered the merit order effect does not depend on the PV penetration rate but rather on the electricity demand profile. The authors will implement a Monte Carlo simulation on irradiation profile. The latter will then be used to reconstruct the hourly time series for PV production over a period of seven years for the countries considered.

Part 2: Study of the market coupling effect.

The main hypothesis that will be tested in this work is the assessment of correlation between electricity market and PV production considering the Market Coupling effect. Power markets in Europe are currently not integrated with other countries' electricity markets. Their organisation at national level can have an impact on the electricity prices since renewables can affect the demand profile generating downward pressure on prices when they feed electricity into the grid. Thanks to a Market Coupling the energy produced by PV could be counterbalanced between countries in order to be able to manage the electricity prices according to the different country demand profiles.

The second part of the study will develop the concept of Market Coupling and the possible impact this electricity market organisation could have. In particular the authors want to prove that even with PV representing a good share of the country power generation, its impact on the electricity market price is very small. This conclusion will be drawn thanks to the support of a quantitative analysis on the ELIX index using the same methodology applied in the first part of the study.

A major contribution of this analysis is the quantitative assessment of the Market Coupling effect on PV impact on the electricity markets. The same methodology could be applied to wind energy. In fact, as PV, it also represents a good share of the power generation of the countries analysed here. This study will sign the pathway to an integrated electricity market which will not only exploit the negative impact of PV on electricity market but also what are at the moment known as weaknesses of the RES-E (i.e. intermittency).