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IN A WORLD WITHOUT SUPPORT SCHEMES: INVESTMENTS IN WIND POWER BY THE ENERGY-ONLY MARKET

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Overview

Today, wind power investments are not driven by the energy-only market signals as other conventional electricity production technologies. Because of their capital cost structure and the variability of the electricity produced, investments in renewable energy sources (RES) are ensured by national support schemes (feed-in tariffs, fixed premiums, contracts for difference, etc.). Thanks to those mechanisms, future incomes of wind power plants are estimated with a low level of risk. In general, investors are highly sensible to the cost structure of technologies and to the risk associated to their expected incomes. With support schemes, RES investors do not bear market and counterparty risks: their produced electricity will be bought at a fix price during a long period (which can last 10 years or even more). Moreover, in most of the European states, the political risk of national support schemes is quite low. Consequently, there are two different investment approaches: a market-based approach for conventional electricity production technologies and a support-based approach for RES technologies.

Recently, RES support schemes have been re-assessed considering that a suitable RES support should be more market-oriented with the aim to gather together all production capacities. In the on-going process of the internal electricity markets, it becomes difficult to maintain a part of the production away from the market signals. The participation of intermittent production to the energy-only market increases financial costs for RES generators but at the same time, it strongly encourages RES generators to act in a more efficient way. In that sense, the European Commission supports the integration of renewable technologies to the electricity market. Following the same trend, different European states have started to rethink their support policies towards renewable energy sources in the electricity sector (electricity market reform in the United Kingdom; Spanish reform of feed-in premium; French consultation on RES support schemes in 2014). In Germany, the reform of the Renewable Energies Act (Erneuerbare-Energien-Gesetz, EEG) will confirm the orientation to a market-based approach for renewable technologies support.

In that context, investments are soon to be based on the energy-only market even for RES technologies. This means a total change for RES investments which will be mainly driven by the market signals. Furthermore, the hourly price can be distorted by the introduction of intermittent renewable technologies - the so called merit order effects (lower average price, greater volatility). Therefore, this paper explores the development of wind power without support scheme. It studies first, under which conditions wind power would be selected by private investors compared to other traditional technologies in different scenarios on the carbon price and the share of variable wind power in the initial technology mix; and second, how it can impact a generation mix on the long term. Two aspects will be focused on: (i) economic profitability of wind power depending on assumptions about CO_2 price or electricity generation mix and (ii) consequences in term of development within an initial mix. These two elements are crucial to estimate the potential development of such a technology by the energy-only market without any support scheme.

Methods

The analysis is based on a simulation tool belonging to system dynamics programming (introduced by J. W. Forrester during the 1960's). Similar modelling is used for the electricity sector by Cepeda and Finon, 2011; Sanchez et al., 2008; Olsina et al., 2006; Ford, 2001.

Given assumptions about initial generation mix, structure of the annual demand curve, energy policy and macroeconomic scenarios, evolution of generation mix is obtained over several years by **endogenous simulation of investment and decommissioning decisions**. The modelling considers a technologically neutral private investor. In this way, green technologies do not benefit from any comparative advantage over traditional fossil-based technologies. The environmental aspect is only taking into account by internalizing negative environmental impacts through CO_2 price.

Investment decisions are traditionally driven by profitability of projects because of a propitious ratio between installed capacities and demand, phasing-out of existing plants or a change in relative cost structures (Green,

2006). In the simulation tool, investors' decisions are obtained each year of the simulation on the basis of estimated profitability of generation projects for a range of anticipated future patterns. For each generation technology, economic profitability from energy-only market is computed for each scenario of a discrete distribution of future conditions based on both anticipations of macroeconomic evolution (electricity demand and fuel prices) and political drivers (such as CO_2 price); and weather uncertainty. Economic assessment takes into account incomes from the energy-only market, investment cost and operating costs. Other costs such as settlement for imbalances are neglected (strong assumption that is discussed in the paper). Finally, yearly investment decisions of private investors are inferred on the basis of a recursive loop which selects the most profitable generation project at each iteration.

Different CO_2 prices and initial generation mixes are tested in order to study under which conditions wind power farms are selected by private investors without any support scheme. The results focus on both economic indicators of wind power and impacts on generation mix.

Results

In the first section, the economic profitability of wind power is studied in order to make the difference between conditions under which wind power is profitable and conditions under which the development of wind power is ensured. The simulations underline the sensitivity of wind economic profitability to both the margin of the system and the CO_2 price. It underlines that economic competitiveness of wind power compared to thermal technologies is achieved for a high CO_2 price which seems to be difficult to reach with the current EU-ETS.

In the second section, the long-term effect of wind penetration is observed and detailed for different case studies. Because the simulation takes into account endogenous effects of past investments on the following decision making phase, long-term effects such as impacts on the generation mix or technology shifts are obtained. A first case study shows the impact of initial wind capacity on the long-term pattern. It suggests that both wind development and wind effect on generation mix depend on the past out-of-the market RES entry. A second case study focuses on the sensitivity of the results to investment cost of wind power and CO_2 price.

Conclusions

Results presented in this paper confirm that the development of wind power is possible only if two conditions are respected: (i) economic profitability of wind power and (ii) economic competitiveness of wind power compared to traditional fossil-based technologies.

More significantly, the paper underlines endogenous long-term impacts of wind power investments on the generation mix given assumptions of CO_2 price, cost of wind power plant and initial mix. Previous out-of-the-market entry of renewable technologies and their cost structures have a strong impact on the transition to a marked-oriented RES development. This suggests that the transition to full market integration of RES should be gradual and guaranteed by strong political orientations.

Main references

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