Andrew W. Thompson

ECONOMIC FEASIBILITY OF WIND ENERGY PARTICIPATION IN SECONDARY RESERVES MARKETS

Andrew W. Thompson: PhD Candidate, Université de Paris-Saclay/Paris SUD 11
54 Boulevard Desgranges, 92330 Sceaux
Phone : +33 (7) 51 48 29 33, e-mail: shetoru@gmail.com

Overview

It is an increasingly difficult terrain for Renewable Energy Sources (RES) in Europe. Increased uncertainty due to energy policy changes, low energy prices due to reduced demand as a consequence of the 2008 Financial and Euro crises, and restrictive market structures have all attributed to a slowdown of RES investment in the Eurozone. As several renewable sources are deemed to be non-mature technologies, investment has been as much tied to investor *speculation* of future energy policy as the current policy reality. The case of Spain is presented in this work as it represents a significant departure from previous policy which has influenced many domestic energy firms to channel investment outside for the near future.

The 2013 Spanish legislation enacted a complete reform of the energy sector in efforts to balance system costs with revenues and reign in the accumulating tariff deficit. Under the new legislation, RES must compete directly against traditional thermal and hydro plants, yet are not allowed in the ancillary services markets for grid stability. Furthermore, wind investments which were made under the assumptions of 20-year economic lives and guaranteed minimum revenue, have now experienced retroactive cancellation of the specialized tariff for renewables known as the Special Regime.

The Special Regime legislation had called for a "reasonable" means of remuneration which would cover the initial investment and all relevant costs to renewable generators. As wind was the number one source of primary energy for Spain in 2013 and as any practical future which is dependent on renewables will necessitate ancillary services provision from a greater number of sources, there has been a growing interest to determine the consequences of allowing wind generation into the Secondary Reserves Market (SRM) for cost recovery.

Method

This research is conducted from a single agent perspective with the intention of answering **if the investment costs necessary to participate in the Secondary Reserves Market will be outweighed by the revenue a wind producer is likely to receive.** Additionally, if true, this work aims to parameterize under what conditions it will be beneficial for a wind producer to participate in the SRM and investigates possible strategies a wind agent could pursue. Finally, this work reiterates policy recommendations to increase market liquidity which would allow for greater penetration of wind and other RES.

An economic cost/benefit model has been developed which is based on market data from the MIBEL power market for the Day Ahead, Secondary Reserves, and Intraday markets. Furthermore, revenue calculation is based on real-time hourly production data and prices as indicated by the market-clearing schedules. As provision of Secondary Reserves would likely require a wind agent to change from a market-clearing schedule to that which would allow for the maximum amount of band offer, this change must be managed by participation in the Intraday Market and may constitute an additional cost. Thus the final calculation of revenue considers Primary Effects (the direct revenues from participation in the SRM), and Secondary Effects (the costs/benefit from bartering power in the Intraday Market). The equation for the Estimated Capturable Income (ECI) is denoted as follows:

$$\boldsymbol{ECI} = \sum_{\boldsymbol{h}} (\underbrace{\boldsymbol{B_h} * \boldsymbol{EFHB_h}}_{\text{Primary Effects}} + \underbrace{\boldsymbol{C_h} * \boldsymbol{IBC_h}}_{\text{Secondary Effects}})$$

Where: $\boldsymbol{B_h}$ is the hourly Band factor or number of MW offered as band in the SRM per hour

$\boldsymbol{EFHB_h}$ is the Effective Hourly Benefit defined as the Secondary Band Price (2BP) markup over the hourly Daily Market Price (DMP) multiplied by the hourly Capacity Factor (CF) and a Realistic Band Offer (RBO) as further explained in the sections of the same names.

$\boldsymbol{C_h}$ is the hourly Cost factor or the number of MW required to be bartered in the Intraday per hour

$\boldsymbol{IBC_h}$ is the Intraday Barter Cost defined as the difference between the hourly Intraday Market Price and the hourly Day Ahead Market Price as further explained in the Intraday Barter Cost section.

Results

Estimated Capturable Income (ECI) is subject to some uncertainty. Thus to give different perspectives on possible revenues, three estimates have been developed: a conservative, a probable, and an optimistic estimate. The investment costs assumed in this research are taken from the TWENTIES Project conclusions. These costs were socialized across a test-bed of 488 MW of installed wind capacity and thus constitute a unitary investment cost of €3,053 per MW. These costs however are subject to significant reduction as the largest cost components were attributed to technical tests and prototyping in addition to the existence of economies of scale.

The principle result is that a wind producer could expect to earn between € 762 and € 1,238 per MW of Installed Wind Capacity through participation in the Secondary Reserves Market annually. When applying this to an existing case, the Huéneja cluster of 254 MW of wind capacity, wind agents could expect to gain between € 193,753 and € 314,712 annually and could recoup investments within three years. Further analysis based upon ten years of simulated inflows imply that the necessary investment for such a cluster would experience an IRR between 35%-56% and constitute an NPV between € 1.1 – € 2 Million for an initial investment of € 523,174.

Two strategies have been defined: a Status-quo strategy (S1), where all wind production is sold in the Day Ahead market and bartered in the Intraday as needed, and a Preemptive strategy (S2) where some production is withheld such that an optimal schedule for provision of Secondary Reserves is obtained directly. The results indicate that maximum benefit can be derived in those hours which experience a Capacity Factor of 41% or greater regardless of the market strategy pursued. However, S2 is deemed be less risky since it is less dependent on positive benefits derived from playing the Intraday market.

Conclusions

In an industry with economic scopes of 20 years or more with the expected regulated rate of return for wind installations at 7.5%, the results indicate that participation in the Secondary Reserves Market would be both economically feasible and attractive.

To allow for wind participation in markets however, policy must first be updated to reflect new technical realities such that: 1.) Wind generators should be allowed to participate in reserve markets, 2.) Service provision should be tested at an aggregate level and allow for portfolio bids, and 3) Upwards and Downwards reserves should be procured separately as independent products, allowing for wind to participate in downward reserves.

References

Ramos, A. (2014, January). Impact of Renewable Energy Sources in Short-term Generation Planning. *ESD.S30: Electric Power System Modeling for the Low-Carbon Economy*. Massachusets Institute of Technology (MIT).

TWENTIES PROJECT 9.1. (2013). *Deliverable 9.1: Test results, with their technical impact and validation, regarding the secondary frequency control demonstration & voltage control demonstration.*

TWENTIES PROJECT 9.2. (2013). *Deliverable 9.2: Technical and Economic Impact on Assets of the Services provided by the Wind Farms.*