WIND
ENERGY
SCIENCE
DISCUSSIONS

Interactive comment on "Ancillary services from wind turbines: AGC from a single Type 4 turbine" *by* Eldrich Rebello et al.

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The study presents an interesting outset, providing evidence of wind turbine capabilities. The style of writing is well understandable and clearly structured.

Literature: The study would have been better informed with a more detailed literature review. As this topic is on the intersect between academic research and industrial R&D, one might want to include more "grey" literature and conference proceedings, as the sole focus on academic publications is insufficient in identifying the current state of development. Without an expanded and comprehensive literature review, I cannot recommend the study for publishing. A more thorough literature review would deliver a large number of results for a large variety of countries and

regions, such as Germany, Ireland, Denmark and Texas. Some relevant pieces of literature to include: https://www.zhb-flensburg.de/dissert/jansen-malte/ (See page 63 for literature review table). https://ieeexplore.ieee.org/abstract/document/7521342 https://www.iee.fraunhofer.de/content/dam/iwes-neu/energiesystemtechnik/de/Dokumente/S Reports/20140822_Abschlussbericht_rev1.pdf (in German but very relevant to the topic) https://ieeexplore.ieee.org/abstract/document/6038993 https://www.sciencedirect.com/science/article/pii/S1364032117309553?via%3Dihub https://scinapse.io/papers/2005811090 http://www.posspow.vindenergi.dtu.dk/

Methodology: In part the methodology is affected by the literature review and the study could have been designed better with the existing evidence in mind. The focus on the technical ability of wind turbines to deliver this kind of service add little novelty to the scientific community, as this already is part of the operational framework of many energy systems across the world. For example under www.regelleistung.net one can access the current conditions for wind to provide this service. Extensive field testing preceded these decisions of regulators and grid operators not just in Germany but across the world. The reader of the paper is led to believe that this is a new capability being tested on wind turbine, which is simply not true. The choice of a single 800 kW IEC Type 4 Turbine, which is presumably a E48 Enercon 800 kW low wind machine, appears as a non-representative choice. Given the variability of a single turbine and turbine type, the overall results are limited to a specific site and its conditions. It would be better to assess the capability of an entire wind farm, or preferably wind farm pool as this would better indicate the future value of wind providing reserves. Setting a 10% regulation band is not state of the art for offering this type of services. The low scores stem from this flaw and misrepresent the abilities of wind. Using probabilistic wind forecast is much more reliable way of determining the offering for wind. This leads to potentially wrong conclusions when comparing wind and fossil generators with regards to their reliability. Problems are being referred to, as e.g. wake effects and available active power, and being dismissed as out of scope. It would be good to have them at least referenced. Here the brevity of the literature review comes to show as the issues

have been researched before (e.g. PossPow project at DTU). It is unclear why AGC signal filtering is necessary and how it complies with PJM market rules. This makes it hard to understand the economic assessment. The economic evaluation could have benefitted from above mentioned PhD (Jansen) with it's open source modelling. A comparison with existing literature would have helped to understand the overall value, e.g. by how much does the income for the generator increase, what is the economic impact on the system, how big is the overall market? More general metrics would help to identify the magnitude of the technology. Disconnecting wind output from prices, i.e. using different areas for these, is a potentially difficult move. The prices of one price area should be correlated with the output of wind and solar. Thus using non-fitting time wind series to the price series would create a different baseline. At several stages, choices are not reasoned (e.g. why not use the P available of turbine?).

Writing: Whilst being comprehensive in most parts, the authors require to much previous knowledge from the reader. E.g. nowhere in the paper, it is explained what a IEC type 4 wind turbine looks like and why it is the right choice for the study. The prices and revenues for the PJM market drop seemingly out of nowhere and must be introduced to the reader, if the paper is to be read outside the US context. The paper seems to be taken out of a larger project. The author doesn't need to know about all the other tests that were conducted but not evaluated. Why start with "Test2" as the first one. That doesn't make sense. A critical reflection of the results is missing. This may be in part due to the aforementioned issues in the literature research. The reader needs to picked up a bit earlier. E.g. how is anyone supposed to know what the products in the PJM markets stand for without extensive research. These things are non-trivial.