Wind Energ. Sci. Discuss.,
https://doi.org/10.5194/wes-2020-30-RC2, 2020


eawe european academy of wind energy
Open Access WIND ENERGY SCIENCE DISCUSSIONS



# *Interactive comment on* "Future Economic Perspective and Potential Revenue of Non-Subsidized Wind Turbines in Germany" *by* Lucas Blickwedel et al.

**Matti Koivisto (Referee)**

mkoi@dtu.dk

Received and published: 8 April 2020

In the paper "Future Economic Perspective and Potential Revenue of Non-Subsidized Wind Turbines in Germany", the authors present a model for estimating future spot market prices in Germany. Two different scenarios towards 2040 are then presented, considering also different CO2 prices. Revenue from a case study wind power plant is compared for different CO2 price scenarios, with a different PPA purchase prices also considered. The paper presents a very important analysis, considering the possible challenges of non-subsidized wind power plants in the future being able to generate sufficient revenue. However, I ask the authors to go through the comments below. The



Printer-friendly version

Discussion paper

authors should clarify especially the LROE concept, and provide clearer conclusions of the presented analyses (these are the two final comments).

1) The authors provide a comparison of the presented electricity price model to literature, but focus mainly on regression/time series type modelling. However, there are methods similar to the presented model implemented in energy system modelling tools, such as PLEXOS (https://energyexemplar.com/solutions/plexos/) or Balmorel (http://www.balmorel.com/; code freely available). It would be beneficial if the authors could expand the literature review to one/some of the energy system modelling tools (some open tools: https://en.wikipedia.org/wiki/Open_energy_system_models).

2) The authors should clarify how the hourly profiles of load and wind and solar generation are modelled towards 2040: 2.a) Wind and solar: In section 3.1., it is said "The annual fluctuations are merely due to different weather conditions in the individual years". But it is not clear to me what weather conditions are assumed, e.g., for 2035 or 2040 (this is not clear from section 2.4). Please clarify (and consider expanding section 2.4). 2.b) Are any changes in the capacity factors of wind and solar generations considered towards 2040, as additional installations (presumably with different technologies, e.g., hub height and turbine type) appear to the system? 2.c) How is load profile modelled for the different years towards 2040? Is the same profile (i.e., time series shape over the year) assumed all the way to 2040, with only the annual energy level changing? Please clarify. 2.d) Are wind, solar and load profiles synchronized? I.e., is for example 2035 defined so that the wind, solar and load data are based on the same weather year (as they all might be correlated due to weather dependencies)?

3) How is annual energy consumption assumed to change towards 2040? As this is a quite fundamental variable for the system, its progression towards 2040 would be nice to see as a figure or table.

4) Considering consumption changes, are, e.g., power-to-gas, electrification of heating and/or electric vehicles considering going towards 2040?





Printer-friendly version

Discussion paper

5) Are cross-border capacities (Table 3) assumed to remain on the 2018 level all the way to 2040? Is this justifiable?

6) In section 2.5, it reads “To estimate power import and export every neighboring country is modelled as a hypothetic power plant with individual capacity and marginal cost”. Please elaborate a little more on this. E.g., how are the very different generation mixtures in the different countries taken into account (hydro in NO, nuclear in FR, and so on)?

7) About Figure 4: It seems that the model cannot capture the likelihoods of the highest spot prices (i.e., the lines diverge going to the left). Can any discussion be given on to why this happens?

8) Word “marketing revenue” is used in many places. I find it a little bit confusing, as “marketing” usually refers to advertisement. Perhaps “market revenue” could be used? (please disregard this comment if “marketing revenue” is an often used term in this context)

9) Understanding Figure 8: The different CO2 prices for the orange bars provide a clear comparison. However, it is not clear to me how the different PPA prices should be considered. How are the 40 €MWh and 50 €MWh linked to the studied expansion scenario B and the different CO2 prices? In the current form, it seems that the 40 €MWh and 50 €MWh are arbitrary prices, and therefore comparisons between direct market revenues and PPAs is difficult.

10) Are transmission bottlenecks inside Germany and resulting possible curtailment of wind generation considered/modelled?

11) Please elaborate more on the LROE concept. Is it based on existing literature? For LCOE, the top part (dividend) are costs, whereas in LROE they are revenue (the divisor seems to be the same in both, namely energy produced). This seems to be a very significant difference (cost = expense vs. revenue = income). Please discuss a

little more on LCOE versus LROE, and why LROE is considered a good measure in the paper. For LCOE, the resulting €MWh value can be understood as the minimum (constant) electricity price over the lifetime to make the project profitable. How resulting LROE values should be understood? (please link the discussion also to the LROE values reported in Figure 8).

12) The Introduction says "A scenario analysis highlights that most of today's wind turbines are not able to yield financial profit over their lifetime without guaranteed subsidies in Germany". However, I don't see this result clearly presented later in the paper. Please provide a clear conclusion section, where each result is presented and explained based on the presented analyses.

---

Interactive comment on Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2020-30, 2020.



Printer-friendly version

Discussion paper