

**Reviewer #3** Panagiotis (Takis) Chaviaropoulos

## **REVIEWER's COMMENTS and Authors' responses**

This article is a joint effort of highly reputed researchers in the field of wind energy to identify critical unknowns in the design, manufacturing, and operability of future wind turbine and wind power plant systems and articulate and recommend relevant research actions.

The paper is complete and well and clearly written. It is not the first time that the reviewer meets the text, as it becomes clear from the Acknowledgements section. Having read and commend on earlier versions of the article, which the authors took under consideration, there is not much new to suggest for further improving the quality of the publication. Some minor comments are:

1. There is an extended list of authors cosigning the publication. It would be nice to know, already from the introduction how these authors came to work together and under which initiative.

**Authors' response** - The following text has been added to the Introduction.

“This article provides the details of research on the turbine that could not be included in the highly condensed article in *Science* which defined three areas of Grand Challenge: the atmosphere, the turbine, and the plant/grid (Veers, et al., 2019a). It also updates the work of the European Academy of Wind Energy (EAWE) in their foundational assessment of long-term research challenges given the emerging understanding of the issues over the last half-dozen years (van Kuik, et al., 2016). This new work is encouraged by the EAWE Publications Committee and is intended to assist the International Energy Agency (IEA) Wind Technology Collaboration Platform (TCP) in generating a revised roadmap for critical wind energy research.

2. Section 1.3 Comment on the scope. The reviewer believes that the scope should be further refined. The paper focuses on “Mechanical Engineering” aspects and does not elaborate on other disciplines that maybe of equal importance for wind energy research. This is not necessary a problem if the boundaries are clearly stated in the scope.

**Authors' response** - This is an excellent point. The following paragraph has been added to the “Scope” section:

“As noted above, design is an exercise that necessarily encompasses a wide range of topics, involving engineering, environmental, and social considerations. However, to set some boundaries on this article and keep the discussion to a manageable length, the topic of social science and the intersection of design with environmental considerations are left to other articles in this series. This article will focus on the mechanical aspects of the turbine, its interaction with the atmosphere and sometimes the ocean, and the critical issues that arise from that perspective.”

3. Some additional references may better support some of the statements in the text. Examples:

a. lines 153-154, statement on non-Gaussian turbulence

**Authors' response** - The following references have been added:

Moeng CH, Rotunno R. Vertical-velocity skewness in the buoyancy-driven boundary layer. *Journal of the Atmospheric Sciences* 1990; 47(9): 1149–1162

Berg, J., Natarajan, A., Mann, J., and Patton, E. G. (2016) Gaussian vs non-Gaussian turbulence: impact on wind turbine loads. *Wind Energ.*, 19: 1975– 1989. doi: 10.1002/we.1963.

H. Gontier, A. P. Schaffarczyk, D. Kleinhans, and R. Friedrich, A comparison of fatigue loads of wind turbine resulting from a non-Gaussian turbulence model vs. standard ones, *J. Phys. Conf. Ser.* 75, 012070 (2007).

b. lines 337-338, machine learning training of low-order models

**Authors' response** - *We have added additional references to the AI/ML sections 9.3 & 9.4 addressing these two introductory paragraphs.*

c. lines 958-960, high-fidelity CFD and ML training low-order models

**Authors' response** - *We have added additional references to the AI/ML sections 9.3 & 9.4 addressing these two introductory paragraphs.*

d. lines 1090-1091, support statement with reference

**Authors' response** - *We have added a sentence pointing to two relevant references, of which one is new in the revised manuscript (Yin et al. 2022).*

e. lines 1677-1679, new materials with increased structural damping (see for instance the DAMPBLADE EU project)

**Authors' response** - *Excellent suggestion. Reference to the DAMPBLADE findings has been added.*

f. lines 1715-1719, new materials

**Authors' response** - *References to the new materials have been added.*

g. lines 1748-1750, new epoxy resin

**Authors' response** - *References to the new epoxy resins have been added.*

h. lines 1800-1801, non-destructive inspection technologies

**Authors' response** - *References have been added on the topic of non-destructive inspection methods for wind blades.*

Given the above, the reviewer's final recommendation for this article is "Publication with minor corrections".

**Authors' response** - *Thank you very much for your review and recommendation!*