Response to Referee 1 Comments

Nico Galarza and Brent Houchens on behalf of the authors, July 28, 2026

Dear Reviewer,

Thank you for the feedback on our manuscript. We have incorporated all major recommendations, which have significantly improved the paper, and the implementation of each is discussed below. We have also incorporated all recommended text and terminology corrections, figure readability improvements, caption revisions, and formatting suggestions.

Best regards,

Brent and Nico, on behalf of the authors

RC1 Comments

Overall, this manuscript provides valuable insights as a rare case study assessing the potential of AWES in a real-world geographic context. The analysis methodology is technically sound and clearly presented, supporting the validity of the results. I recommend the paper for publication.

However, the manuscript could be further strengthened by including a quantitative comparison between conventional tower-based wind grid systems and AWES-based systems. Such an analysis would more rigorously demonstrate the advantages of AWES, particularly in disaster-prone regions.

While not fully quantitative, we have attempted to strengthen the argument for AWES and against conventional tower-based wind via the following several points that make towered wind very challenging in Puerto Rico:

1) A conventional towered wind farm was destroyed by a hurricane in Puerto Rico as described in Section 1.2 Case Study for Culebra, Puerto Rico, including the text:

   "Commencing operation in the year 2012, this towered wind farm provided enough energy to meet the demand for 9,000 homes in different towns near the eastern coast. Unfortunately, it was destroyed with the passage of category 5 hurricane Maria in 2017, after just 5 years of service (PREPA, 2019).… This example provides a clear representation of the high-risk for natural disasters the islands present, offering a realistic stress-test environment for newly emerging AWE technologies which feature the ability to store rapidly, then redeploy quickly after a storm passes."

2) Updated Figure 9 demonstrates that the average wind speed at each hour, for the best and worst wind resource years out of the 7 years of data, respectively. Though not a

complete picture of the hourly resource as it does not convey the tails of the distribution at any hour, it still demonstrates a very marginal wind resource for towered wind applications at 100 meters (typical towered wind hub heights for MW scale machines). Such large, towered turbines would also again be very susceptible to hurricanes. Smaller turbines at a few 10s of meters of hub height might be more resilient to storms, but the wind resource there would be even further diminished as shown in Figure 5. This is captured in the text of Section 2.5 Selection of Culebra for Case Study with the following:

"Considering the modest wind resource at 100-m altitude and below, along with the relatively high frequency of catastrophic storms, the deployment of towered wind turbines is likely to remain challenging in Puerto Rico. However, airborne wind could be attractive given the improved wind resource at 200-m altitude and above, coupled with the ability of AWES to land during storms and then redeploy quickly after."

We believe these expansions make the case that towered wind is not very practical in Puerto Rico. The results then go on to show that AWES, especially when coupled with solar PV, are very attractive even for the modest wind resource available.

10: Consider revising "three AWES systems" to "three AWES," as the term AWES already implies "systems."

We agree and have revised accordingly. Additionally, AWESs is now used for the plural, as suggested by EC1.

65: Consider increasing the label size for key areas (e.g., Puerto Rico and Culebra) in Figure 1 to improve readability.

We have increased the font size of the labels and used a higher resolution image for Figure 1.

110: It would be helpful to include a callout for Culebra on the map (Figure 5). Consider to increase font size of Figure 9 and 12

We have replaced low-resolution images with higher-resolution versions (and included a callout of Culebra in Figure 5) and increased font size throughout.

170: A more detailed description of the MDT software would be helpful. While readers can infer some of its capabilities from the results section, providing a clear introduction to the tool—

preferably before the statement “Various optimized systems were identified using MDT software…”—would improve clarity.

We agree - this was an oversite on our part. A dedicated description of Microgrid Design Toolkit (MDT) has been added in Section 3.2.1 Microgrid Design Toolkit. It introduces MDT optimization capabilities and its role in evaluating microgrid performance under outage conditions and design basis threats (DBT’s), as well as highlighting performance specific to this study.

195: Could you elaborate on the statement that “the power curve is dependent on the required frequency of reel-in phases”? My understanding is that the Skysail power curve is defined as the average net cycle power and therefore already incorporates the energy consumption associated with reel-in for each wind-speed.

The referee is absolutely correct as per the SkySails presentation at AWEC 2024 – we have removed this statement from the paper and also have better clarified the assumptions we made to consider a wind resource at 300-m altitude in Section 3.1.

280: What criteria were used to assess feasibility in terms of energy availability and cost? The Pareto diagrams (Figures 17 and 18) suggest that feasibility is determined primarily, if not exclusively, by the performance criterion. Was a cost criterion also applied in distinguishing the red versus green solutions?

System feasibility was indeed first determined through energy availability metrics for both priority and non-priority loads during outage events – this is now explicitly mentioned in Section 3.2.1 Microgrid Design Toolkit.

Cost was not used as a pass/fail criterion. Instead, cost was used as a secondary metric in MDT to select the most cost-effective design that satisfied the primary energy availability requirements for the priority load (PL) and non-priority load (NPL). Cost analyses were also included to estimate the maximum allowable capital expenditure capable of meeting the target LCOE of 26 ¢/kWh. This allowable cost was calculated from the annual energy production, assumed losses, operating expenditures, and the fixed LCOE target.

Discussions of allowable CapEx have been clarified and expanded in Sections 3.3 Technoeconomic Considerations, and 4.1 Annual Energy Production per AWES and Allowable AWES CapEx.