Author's response 2

Report Comment

Changes in Manuscript (The lines refer to the LaTeX-diff file.)

Report Comment 1 (22nd April 2025):

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Report Comment 2 (27th May 2025):

The manuscript presents a comparative study on three backup power supply systems (H2-FC+BS, H2-ICE, H2-ICE+BS) for hydrogen-production offshore wind turbine, based on historical wind speed and temperature data in the German Bight. However, several important issues in the methodology and clarity of technical assumptions need to be addressed before the work can be considered for publication.

1. Technical Assumptions and References:

• In lines 50–55, the authors assume a constant base load of 7 kW and a total power requirement of 50 kW. However, the rationale behind choosing these specific values is not provided. Are they based on empirical data, design guidelines, or previous studies? Proper citations are necessary to justify these assumptions.

ll. 56-58 -> An explanation of the origin of the assumed load profile has been added.

• The treatment of hydrogen storage capacity is unclear. For example, Fig. 10 does not appear to include any estimation of the space required for hydrogen storage. Since the hydrogen storage capacity critically affects the operational duration of both the FC and ICE systems during standstill periods, this omission introduces uncertainty into the subsequent analysis.

ll. 140-142 + l. 178 -> In the system descriptions, it was explained that the required hydrogen is taken from the pipeline network, so that no additional storage is planned.

ll. 291-293 -> In the results section "Space consumption", it was pointed out that no hydrogen storage facilities are planned, as the hydrogen is taken from the pipelines.

• The standstill time is simplified into two scenarios (20 min and 6 h). However, this simplification raises a valid alternative: could a 300 kWh battery (i.e., 50 kW × 6 h) serve the same function? The manuscript should discuss this possibility and justify the advantage of hydrogen-based systems over a purely battery-based solution for this use case.

ll. 316-322 -> The point was included in the discussion and the scenario described was explained there. It is explained why a pure battery storage system is not expedient, although it would theoretically be possible because of the simplified consideration. The advantages of using hydrogen are highlighted.

2. Control Strategy of Hybrid Systems (H2-FC+BS and H2-ICE+BS):

• For hybrid systems involving battery storage (BS), more detailed discussion on control coordination between FC/ICE and BS is essential. The authors correctly mention (lines 150–155) that a battery is required for FCs to reach operating temperature before full load. However, there is no comparable explanation for the ICE+BS system.

ll. 158-161 -> The control strategy of the fuel cell system was explained in more detail.

ll. 185f -> The start point of the combustion engine is described in more detail.

• As a result, it is difficult to interpret the results shown in Table 5, particularly the higher battery cycling count in the ICE+BS configuration compared to FC+BS. Is this due to differences in startup characteristics, control logic, or load-following behavior? These aspects need further elaboration.

ll. 246-251 -> An explanation of the different life expectancies of the battery storage system in combination with the fuel cell and the combustion engine has been added.

3. Efficiency Data and Inconsistencies:

• The efficiency curve presented in Fig. 8 lacks explanation. How was this curve derived? Additionally, there is an inconsistency regarding the thermal management of FC vs. ICE. The authors note (lines 165–170) that ICEs require smaller cooling systems due to their higher operating temperatures. Yet, in lines 195–200, it is stated that both FC and ICE systems exhibit the same efficiency at 50 kW. This raises questions about whether the different thermal characteristics have been adequately considered in the performance comparison.

ll. 200 - 202 -> The explanation of the calculation of the efficiency curves has been detailed.

ll. 177f -> The effects of the higher operating temperature and the higher exhaust gas heat flow on the cooling system were described in more detail.

ll. 204-207 -> The different power consumption of the cooling systems has been detailed.