Wind Energ. Sci. Discuss., referee comment RC1
https://doi.org/10.5194/wes-2021-39-RC1, 2021

Comment on wes-2021-39

Anonymous Referee #1

Referee comment on "Exploitation of the far-offshore wind energy resource by fleets of energy ships – Part 2: Updated ship design and cost of energy estimate" by Aurélien Babarit et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2021-39-RC1, 2021

General comments

This article documents the early design stages of a creative, renewable Power-to-Liquid system. The article is written in generally good language. The technical aspects of the proposed energy ship are documented appropriately for a case study and assumptions/references are transparent. The economic evaluation of the concept is documented transparently too. The main critique point is specific comment no. (10). The critique refers to the methanol price projections and is decisive for the market potential of the proposed solution and eventually the conclusion of this article. I recommend this point being double-checked by another reviewer.

Specific comments

- Line 22: "the cost may be comparable to that of methanol produced by offshore wind farms in the long term" – see specific comment no. (10).
- Line 35: It would be helpful for the reader if you shortly mentioned up to three main reasons for your choice of methanol, based on your referenced previous assessment.
- Line 55 and following: As far as I understand, your proposed design has progressed and you provide comparisons/updates to previous estimates. This documentation in itself may be of value, as it showcases how weight or cost estimates develop throughout subsequent design stages. A short sentence highlighting this value could bring attention to this aspect.
- Lines 67 & 88: you refer to eq. 2 from Barbarit et al. 2020 twice, hence it seems to be relevant for this study. Consider showing that equation explicitly here instead of only referring to the previous article.
- Line 82 (Figure 4): You could indicate the vector of the propulsive force with an arrow in the left part of the figure. Potentially four arrows with lengths proportional to each FR's force contribution.
- Line 97: since the displacement has changed, I assume the hull shape has changed too.

'The hull shape (Wigley hull) has been updated based on a more accurate displacement estimate' could clarify this.

- Lines 116-122: Consider mentioning the efficiency of the H2-to-methanol plant as well in order to increase transparency.
- Lines 182 & 201: You could improve understanding by framing the annual methanol production capacity in terms of vehicles powered. E.g. units of 5000 dwt bulk carriers propelled:
  70,600t/year = 388,300MWh/year chemical energy
  assumptions annual energy consumption bulk carrier: 1,410kW x 24h/day x 180days/year = 6,091MWh/year
  6,091MWh / 50% thermal engine efficiency = 12,182 MWh/year chemical energy
  388,300MWh / 12,182MWh = 32 vessels that could be powered by the designed fleet
- Section 4.2 and 4.3: Would it be more logical to switch the order of these two sections? A comparison of alternative carbon-neutral methanol production pathways first and market potential second (potentially only of the best candidate solution) seems more intuitive.
- Figures 8, 9 and 10 and lines 360-364: If I understand the concept of learning rate correctly, you assume that the (levelized) cost of methanol decreases by 10% for each doubling in capacity. Many of the capital-intensive systems (shown in Figure 7) use existing technologies, and in particular technologies that are used in offshore windfarms and connected methanol production plants too. The cost for the same technology however will not develop significantly differently depending on whether the technology is installed onboard the energy ship or in offshore wind farms. Put differently, the cost decrease should be seen in relation to the worldwide installed capacity of the technology, not the energy ship (or fleet) alone. In that case, the costs of the energy ship would not fall as quickly as projected and the system thus not be competitive.
  On the other hand, it may be argued that the cost of offshore wind methanol increases with increasing installed capacity, as windfarms need to move to more distant offshore locations. The energy ship seems to be a rather robust solution to this issue, as it is relatively insensitive to shore distance and water depths.
  I recommend these cost projections being carefully double-checked. They do not affect the technical assessment, but have a significant effect on the market potential and hence the conclusion of this article.

Technical comments

- Line 16: consider taking out the reference from the abstract.
- Lines 16-17: you mention the "energy performance has been assessed". Hence the statement "aim is to estimate the energy […] performance" seems confusing. 'Revisit' or 'update based on design progression' might clarify this.
- Line 18: "wind-assisted propulsion experts" (without 's)
- Line 30: consider replacing "low-carbon alternatives" by 'climate-neutral'/'carbon-neutral' or similar.
- Line 32: '**a** sustainable fuel' or 'sustainable fuel**s**'
- Lines 38-39: consider replacing "sustainable" by 'carbon/climate-neutral' or similar to be more precise.
- Line 49: Do you mean 'levelized' cost of energy? In that case, it can be advantageous to mention that explicitly.
- Line 58: Figure 2 (not 3)?
- Line 61: Consider replacing "Justifications" by 'explanations' or similar.
- Table 1: Be consistent with using either H_2 or H2 and CO2 or CO_2

- Line 71: ‘formulas’ or ‘a formula’
- Line 230: Consider making an ordinary reference to this weblink.
- Figure 7: an exploded pie chart (pieces grouped by CAPEX, OPEX and others) can improve the understanding of the figure.
- Line 401: The title of this reference seems to be wrong.