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EPIC Research Roadmap on Utility-Scale Renewable Energy

Comment 1: Re: Initiative OSW.3: Integrate Wave Energy Systems with Floating Offshore Platforms
Comment summary: Suggest to solely focus on co-locating wind and wave farms instead of combining technologies using the same permits, export cables, installation and maintenance vessels but leaving distinct clearance between both farms (see Fig. 4. & 5. Cable layout for co-located array, https://doi.org/10.1016/j.renene.2018.08.043).

Justification:
Standardized complex offshore operations to operate and maintain offshore wind farms do not allow to add additional, new complexity in the beginning.
â€¢ Previous studies on combined platforms:
o US DOE: https://www.osti.gov/biblio/1057931-windwavefloat-wwf-final-scientific-report
o US DOE:
https://www.energy.gov/sites/prod/files/2013/12/f5/11_wwf_principle_power_weinstein.pdf
o EU: Marine Renewable Integrated Application Platform,
https://cordis.europa.eu/project/id/241402
o EU: https://www.renewableenergyworld.com/2019/12/02/marine-power-systems-receives-funding-to-accelerate-combined-wave-and-wind-technology/#gref
Suggestion:
Suggest to solely focus on collocating wind and wave farms instead of combining technologies using the same permits, export cables, installation and maintenance vessels but leaving distinct clearance between both farms to achieve:
1. Increase combined capacity factors and respective system level cost of storage
2. Reduction in CAPEX by utilizing shared project cost and infrastructure
3. Reduction in OPEX by utilizing shared vessel and vessel trips
Sources for 1. & 2.:
â€¢ 2018: Fluctuating solar and wind power require lots of energy storage, and lithium-ion batteries seem like the obvious choiceâ€"but they are far too expensive to play a major role - https://www.technologyreview.com/s/611683/the-25-trillion-reason-we-cant-rely-on-batteries-to-clean-up-the-grid/
â€¢ 2019: E3 & Castle wind study: A newly released study from Energy + Environmental Economics (E3), the leading experts on Californiaâ€™s electricity market and the clean energy transition, has found that offshore wind off the coast of California could save California ratepayers up to $2 billion on a net present value basis by 2040 through the installation of 7-9 gigawatts (GW) of offshore wind. - http://castlewind.com/offshore-wind-in-california/
â€¢ 2010 Stanford: System Integration Value = Power that meets Peak Load/Average Power Supplied: 88%: â€œCombined wind and wave farms in California would have less than 100 h of no power output per year, compared to over 1000 h for offshore wind or over 200 h for wave farms alone. Ten offshore farms of wind, wave, or both modeled in the California power system would have capacity factors during the summer ranging from 21% (all wave) to 36% (all wind)

with combined wind and wave farms between 21% and 36%. The capacity credits for these farms range from 16% to 24% with some combined wind and wave farms achieving capacity credits equal to or greater than a 100% wind farm because of their reduction in power output variability.
o https://energy.stanford.edu/sites/g/files/sbiybj9971/f/estoutenburg23apr2012.pdf
o https://www.youtube.com/watch?v=AgUKuw7d4vg
o
https://web.stanford.edu/group/efmh/jacobson/Articles/I/Wind&wave/WindWaveStoutenburgRenEn2010.pdf
o http://orca.cf.ac.uk/8386/
â€¢ 2018: AEP of colocated Offshore Wind Farm AEP 652,453 MWh/year, Wave 465,278 MWh/year, https://doi.org/10.1016/j.renene.2018.08.043
â€¢ 2015: Output power smoothing and reduced downtime period by combined wind and wave energy farms, http://dx.doi.org/10.1016/j.energy.2015.12.108
â€¢ 2009: Variability reduction through optimal combination of wind/wave resources â€“ An Irish case study: â€œIt is shown how the West and South coasts experience, most of the time, wave systems where the predominant (from an energy point of view) part is composed of large swell systems, generated by remote wind systems, which have little correlation with the local wind conditions. This means that the two resources can appear at different times and their integration in combined farms allows a more reliable, less variable and more predictable electrical power production. The reliability is improved thanks to a significant reduction of the periods of null or very low power production (which is a problem with wind farms). The variability and predictability improvements derive from the smoothing effect due to the integration of poorly correlated diversified sources.â€ - doi:10.1016/j.energy.2009.09.023
Sources for 3.:
â€¢ 2018: Co-located wave-wind farms for improved O&M efficiency,
https://www.sciencedirect.com/science/article/abs/pii/S096456911730087X