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Flexible Multi-use Offshore Renewable Energy Platforms (Flexi-MORP)

Improving the economic feasibility, sustainability and social value of offshore renewable energy solutions: A case study of the North Sea, UK EEZ

N Saduagkan[i], M-A Cardin[i], R O'Shea[ii]

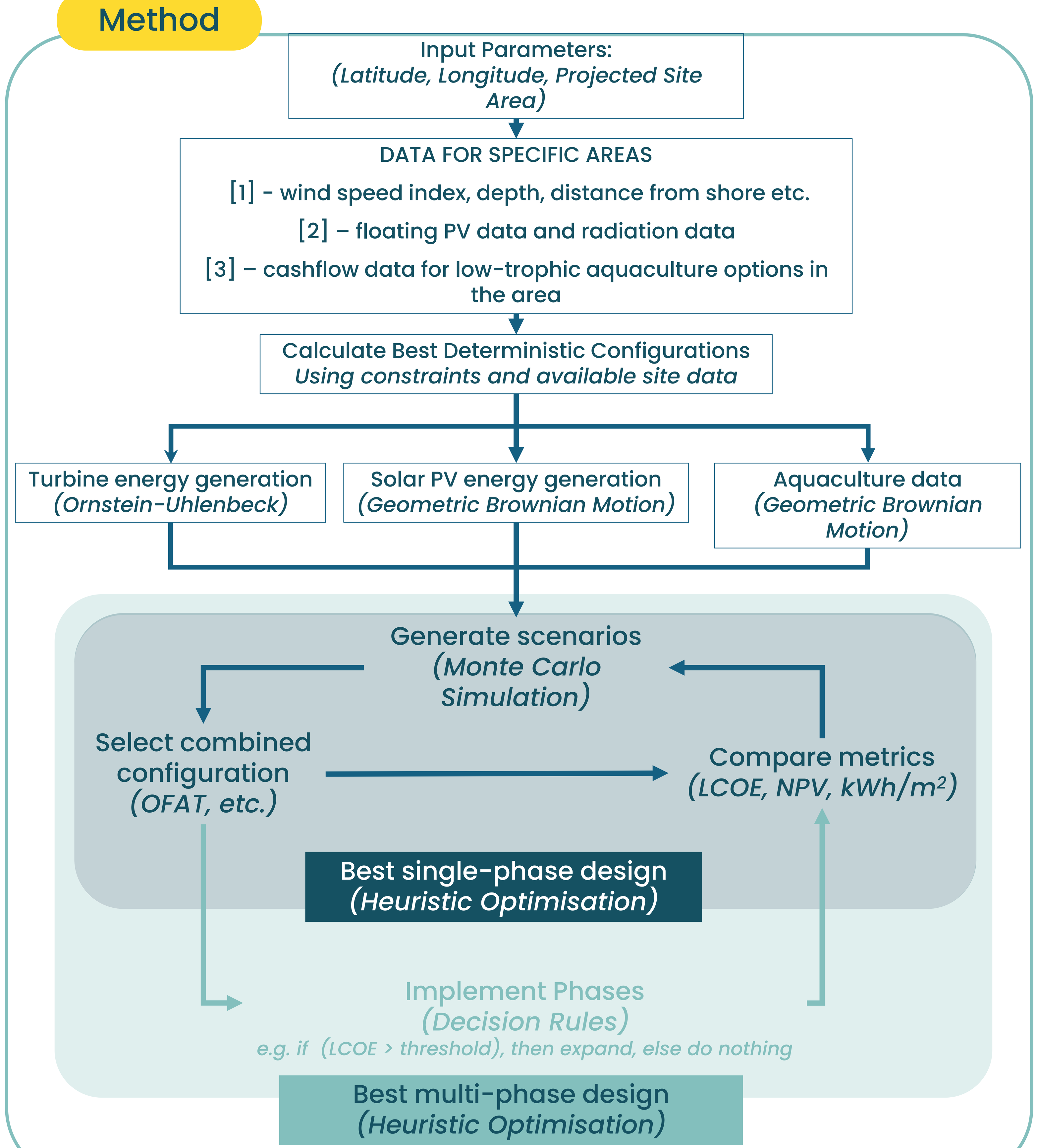
i. Imperial College London, Dyson School of Design Engineering

ii. Imperial College London, Department of Chemical Engineering and Sargent Centre for Process Systems Engineering

Aims

1. Aids the decision-making process for the design of an offshore multi-use platform
2. Allows for the most effective, efficient and strategic use of marine space
3. Effectively utilise *Real Options*: the right, but not the obligation to make a certain decision

Method



Future Work

1. Refining the results and expanding to a larger scale
   a) Identify and improve shortcomings in current modelling
   b) Explore further techniques for optimising decisions
2. Conduct a thorough sensitivity analysis to analyse to identify most impactful variables for further risk mitigating strategies

Results

1. Full Configuration

- Wind Turbines (IEC 1)
  - 6 x 15MW, *fixed*
- Floating PV (up to 700 kWp)
  - 2 x 50 Ha
- Aquaculture (brown algae)
  - 4 x 4 Ha

2. Phases

Year 0:
- Set up substation & wiring for *full configuration*
- Deploy 3 turbines, 3 algae farm areas

Years 3-5:
- Deploy the rest

Year 30:
- Decommissioning

3. Monte-Carlo simulation

Variable under uncertainty	LTA - yearly	St. dev. (%)	Modelling technique
Wind energy production	42 MW	30	Mean Reversion
PV energy production	8 MW	10	Normal Distribution
Aquaculture pricing	£16.5k/ tonne	8	S-curve

4. Results:

Configuration	LCOE (£/MWh)	ENPV* (£000s)	Payback period (years)
Wind only	154	-242	-
Wind and PV	146	-116	-
Wind and Aquaculture	196	22.4	27
All, single phase	112	312	16
All, multi-phase	108	340	19

Rounded to 2 significant figures.
*assumes a fixed electricity price for project lifecycle

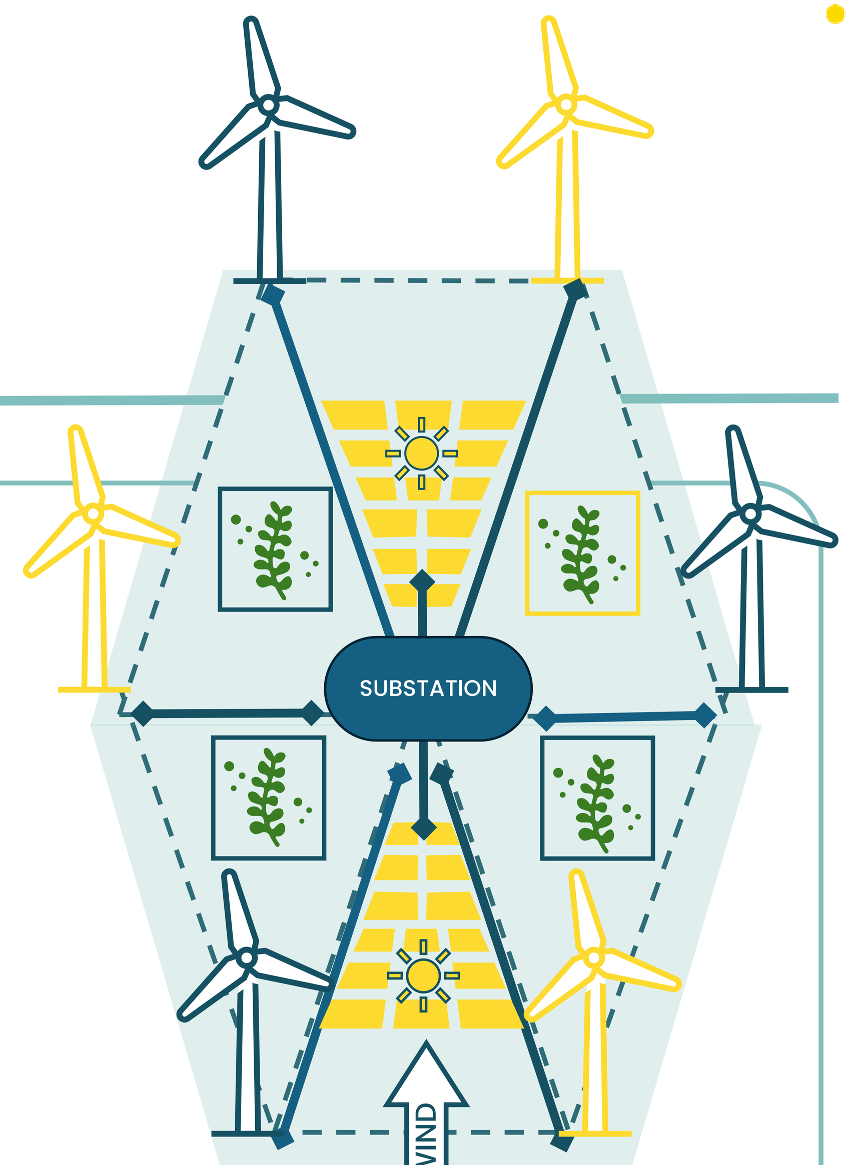


Fig 1:
Best flexible configuration, 3km², 48m depth

Key
- Phase 1
- Phase 2
- Wiring
- PSA boundary
- Turbines
- Floating PV
- Aquaculture

Fig 2:
Wind direction variability[1]

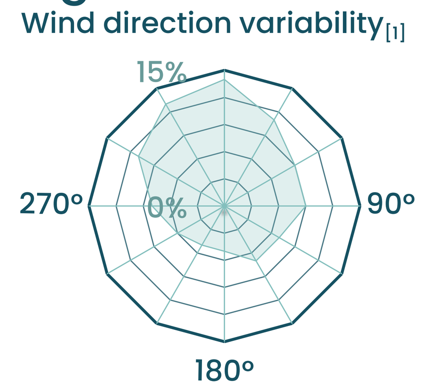
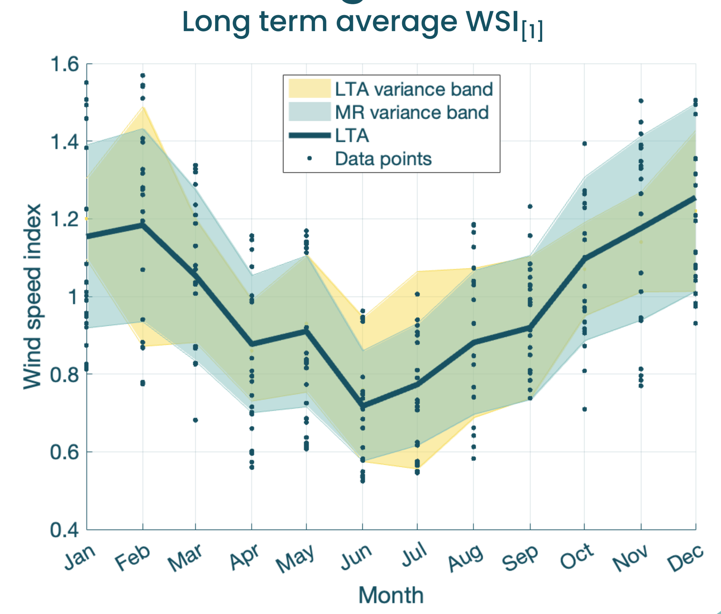


Fig 3:
Long term average WSI[1]



Conclusion

Flexibility in deployment phase and configuration shows promising results.
- PV panels balance Summer months with lower wind speeds
- Aquaculture provides better value sold fresh vs. biofuel

Planned deployment under uncertainty mitigates risks – wait for more information before making decision

[1] Neil N. Davis et al; *The Global Wind Atlas: A high-resolution dataset of climatologies and associated web-based application*; Bulletin of the American Meteorological Society, Volume 104: Issue 8, Pages E1507-E1525, August 2023, DOI: https://doi.org/10.1175/BAMS-D-21-0075.1
[2] *Global Solar Atlas 2.0, a free, web-based application is developed and operated by the company Solargis s.r.o. on behalf of the World Bank Group, utilizing Solargis data, with funding provided by the Energy Sector Management Assistance Program (ESMAP)*. For additional information: https://globalsolaratlas.info
[3] Brian Menzies et al, *Economic feasibility study on seaweed*. Available at: https://crownestatescotland.com/sites/default/files/2023-07/economic-feasibility-study-on-seaweed.pdf