

MARINE HYBRID ECO-PARKS Techno- economic analysis in potential Latin America markets



PAMEC 2024
Pan American Marine Energy Conference
Barranquilla, Colombia Jan 22-24, 2024



CEMIE-Océano
Asociación Civil



Pan-American
Ocean Energy
Student Network

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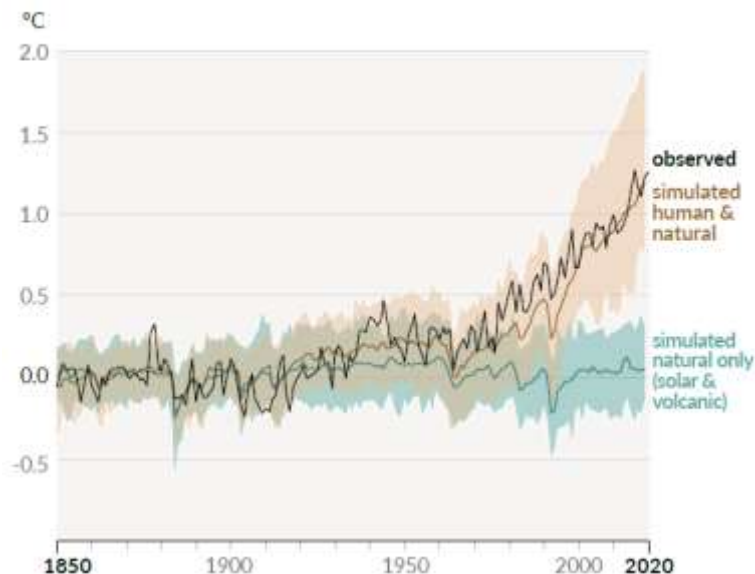
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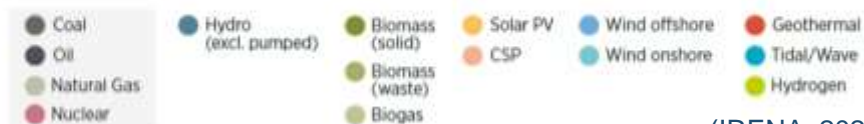
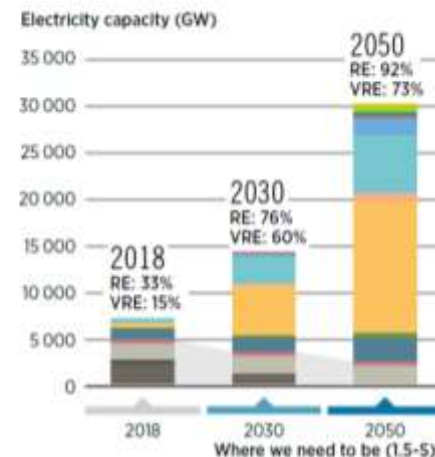
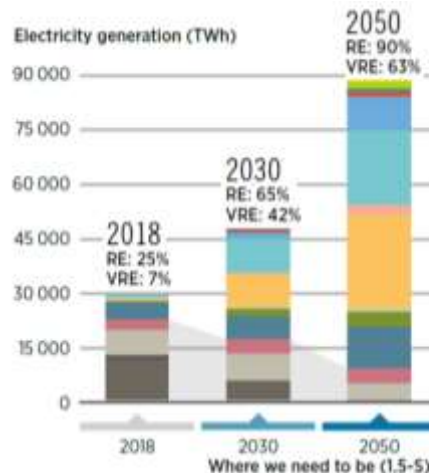
January 22, Barranquilla, Colombia

MOTIVATION

b) Change in global surface temperature (annual average) as **observed** and simulated using **human & natural** and only natural factors (both 1850-2020)



(IPCC, 2022)



(IRENA, 2022)

Innovative
Solutions



1. INTRODUCTION



Marine renewable energy (MRE): all forms of energy derived from the seas and oceans.

RENEWABLE OCEAN ENERGY

These devices turn the energy from moving water and wind into electricity. Underwater power cables carry the electricity to shore, where our homes, schools, and businesses can use it.

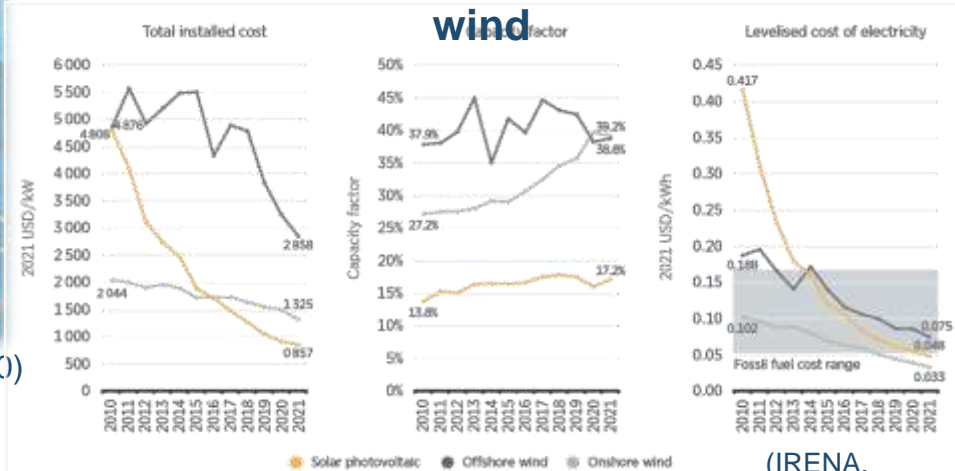


(NREL, 2020)



(CEMIE-Océano, 2019)

Offshore wind vs. Solar PV & Onshore



(IRENA, 2022)

1. INTRODUCTION



Harnessing wave energy

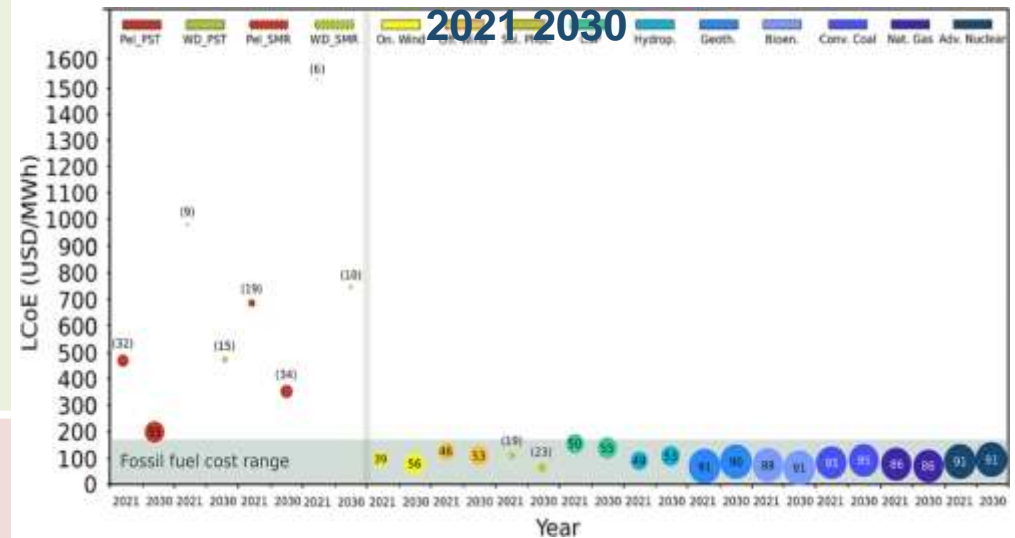
Potential Advantages

- High energy density per unit area.
- Predictable and flows naturally from generation areas to the coast.
- Harvested and transformed into other forms of energy via wave energy converters (WECs).
- Significant progress in the technological readiness levels (TRL), future energy supply.

Potential Challenges

- Resource variability and intermittency.
- High cost of technology installation.
- Uncertainties associated with the large and diverse portfolio of WEC prototypes, and commercial-scale performance.
- Lack of energy policy sensitivity.

LCoE & Cf by different energy options at



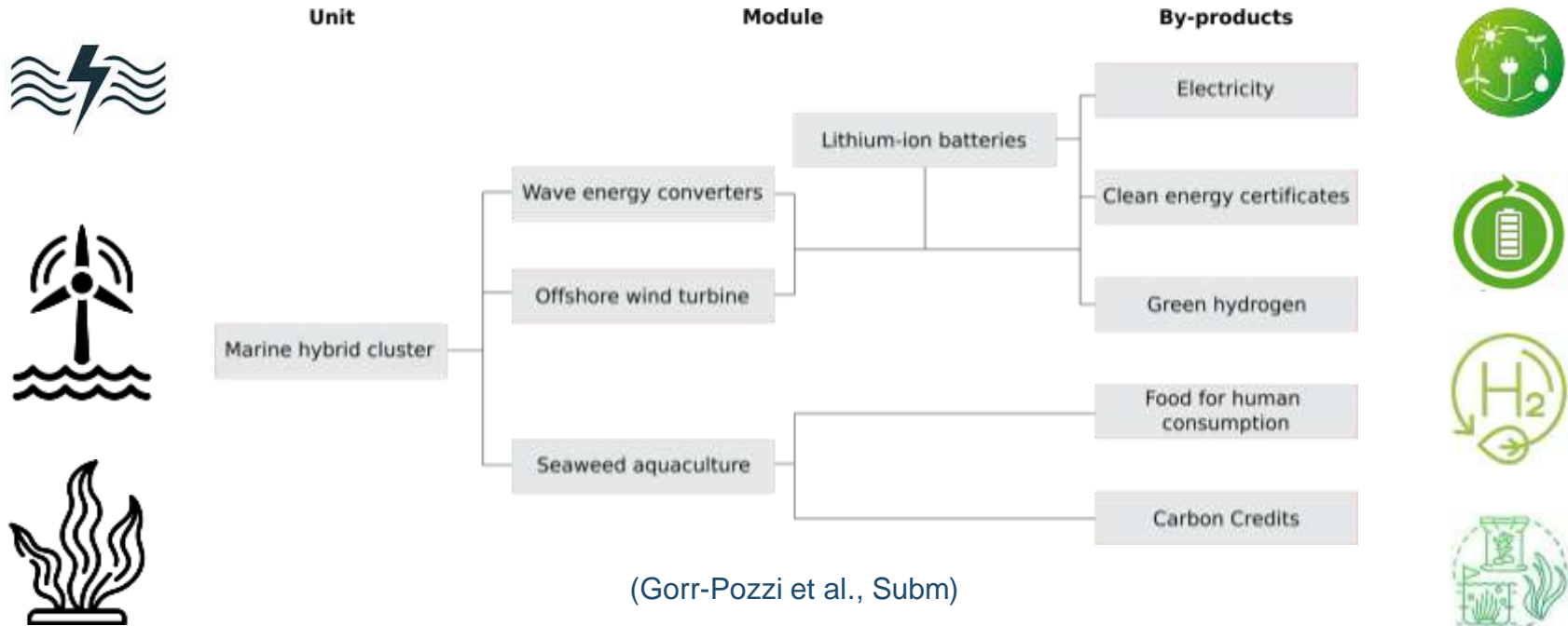
(Gorr-Pozzi et al., 2023)

1. INTRODUCTION



Goal

Evaluate the **techno-economic feasibility** of **Marine Hybrid Clusters** coupled with a **wave-offshore wind hybrid renewable (WWHRS)** and **marine aquaculture** systems to satisfy with electricity, green hydrogen, and food resources and **energize the blue economy** at two potential sites in **Latin America**.



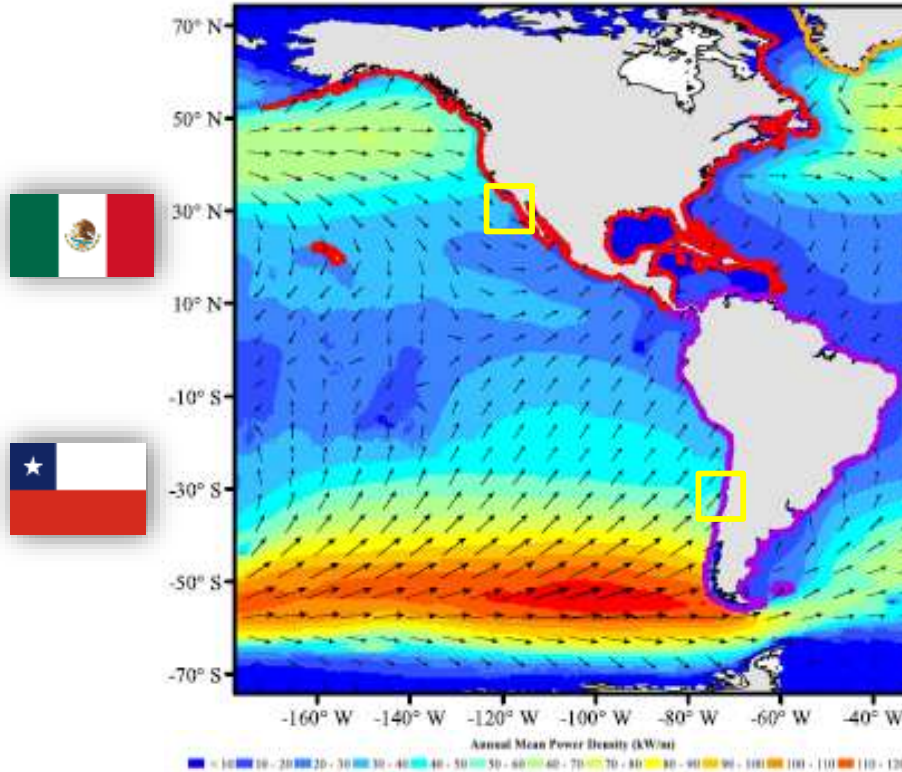
(Gorr-Pozzi et al., Subm)

2. METODOLOGY

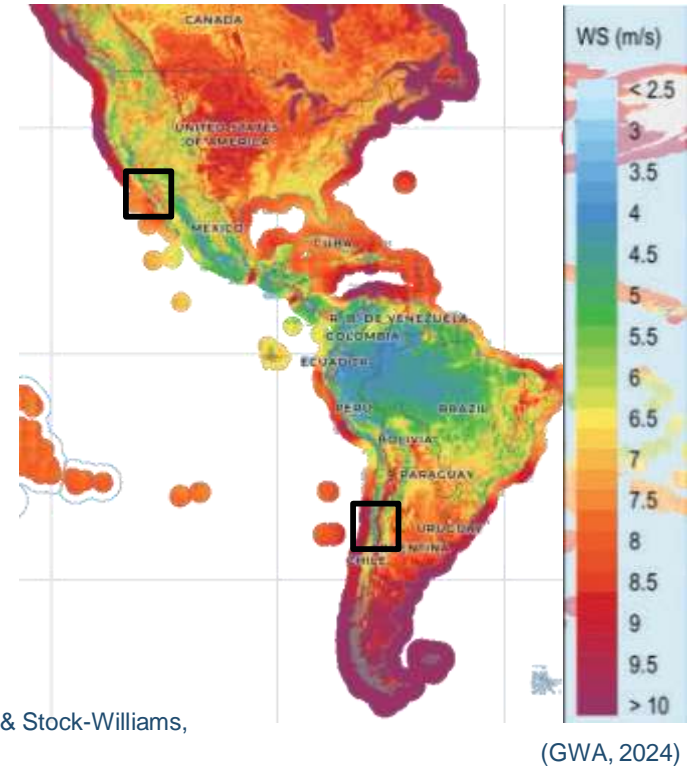


Field site. La Serena (Chile) and Ensenada (México)

Mean Wave Power availability



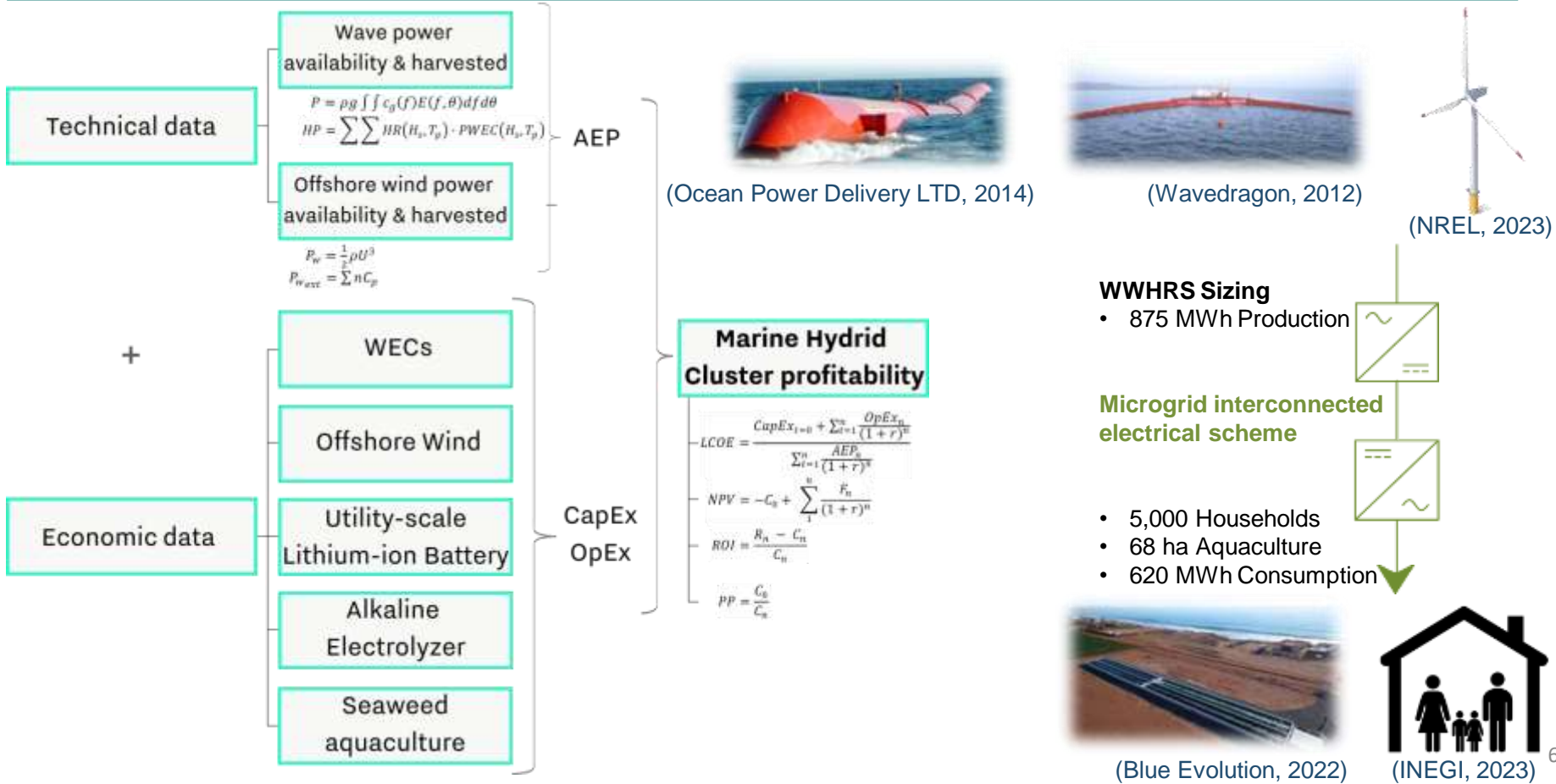
Mean Offshore Wind Power availability



(Gunn & Stock-Williams, 12)

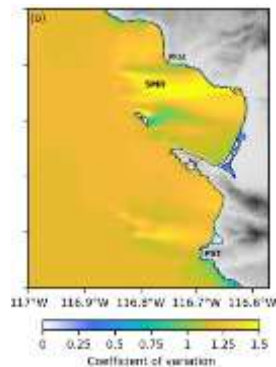
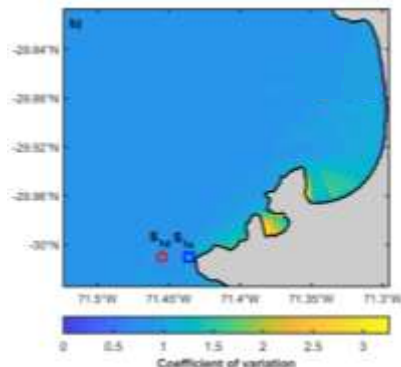
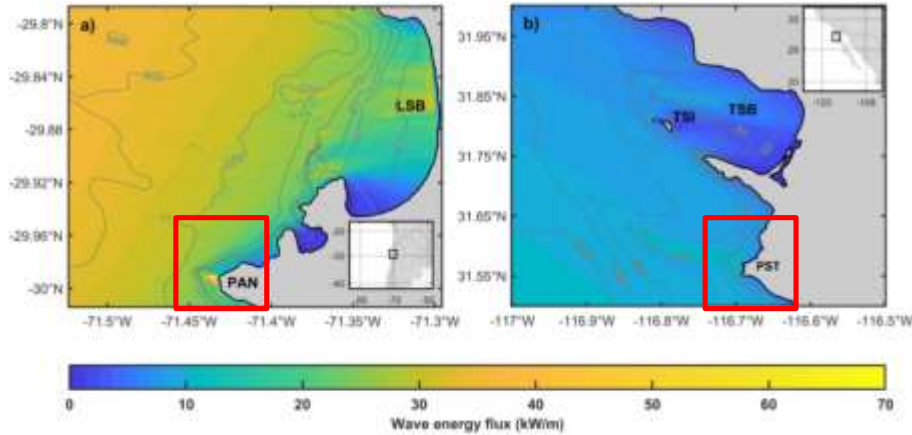
(GWA, 2024)

2. METODOLOGY



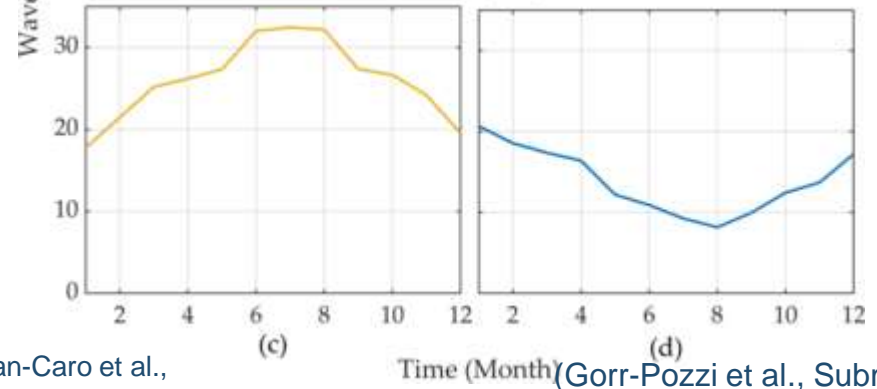
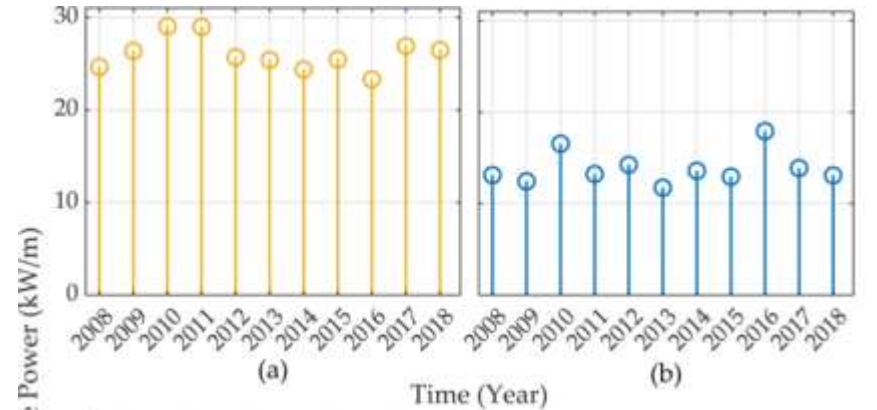
3. RESULTS

Mean wave power availability and variability



PAN- La Serena

PST- Ensenada



(Selman-Caro et al., 2024)

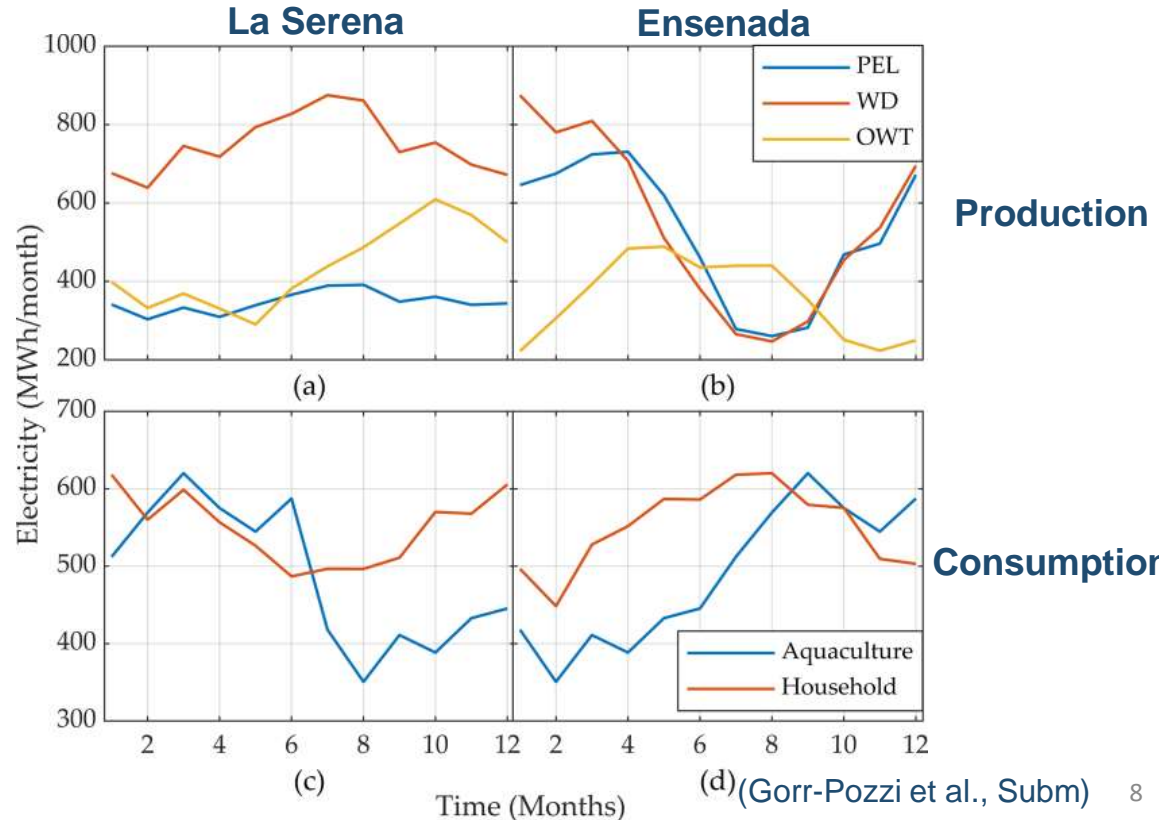
(Gorr-Pozzi et al., Subm) ⁷

3. RESULTS

Energy balance. Electricity generation-consumption profiles

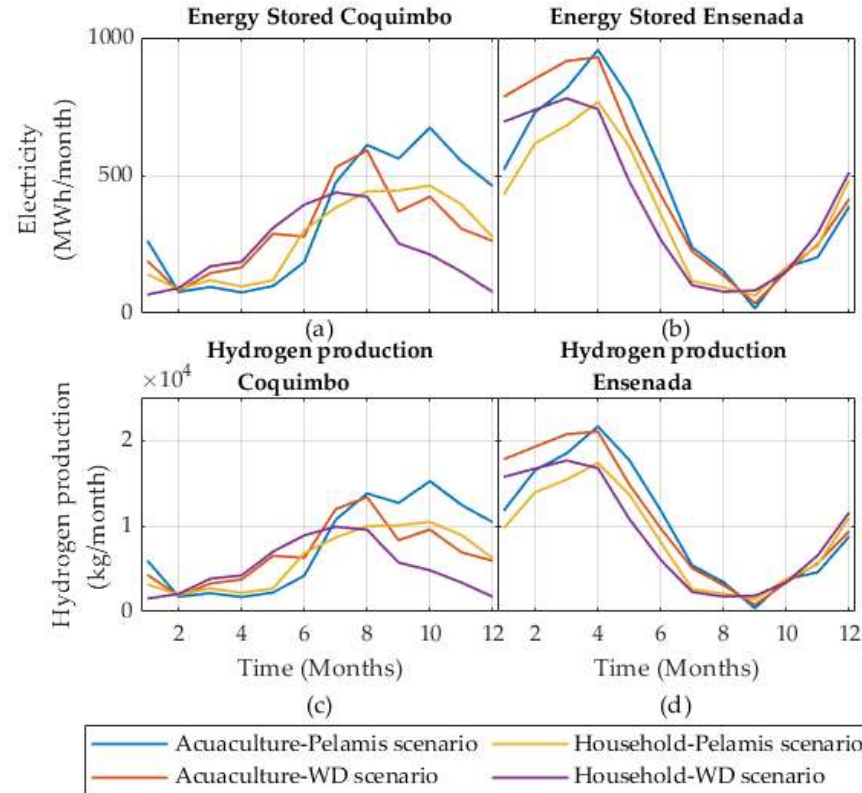
TABLE I
DESIGN PARAMETERS FOR WAVE-WIND HYBRID RENEWABLE SYSTEMS
(WVWHS) IN THE MAIN SCENARIOS

Main scenarios	Hybridization	Number of WEC	Number of OWT
Coquimbo- PEL-OWT Aquaculture Coquimbo	44.23%	6	1
Household Coquimbo WD-OWT Aquaculture Coquimbo	N/A	1	0
Household Ensenada PEL-OWT Aquaculture Ensenada	59.56%	5	1
Household Ensenada WD-OWT Aquaculture Ensenada	60.48%	3	1



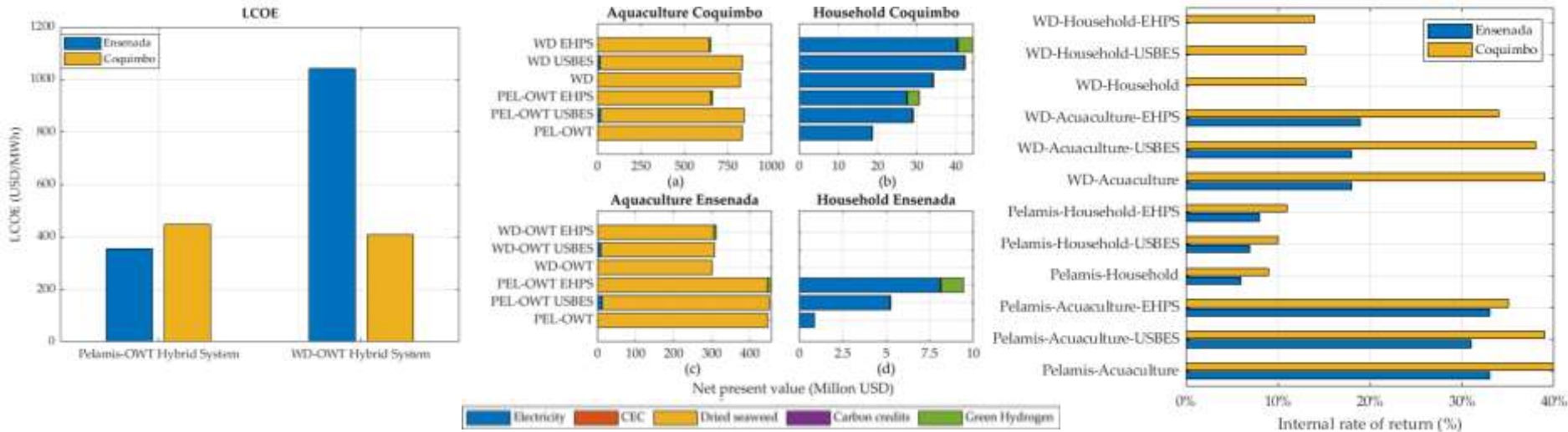
3. RESULTS

Surplus energy used in utility-scale battery energy storage systems (USBES) and hydrogen production by electrolysis (EHPS)



3. RESULTS

WWHRS profitability



(Gorr-Pozzi et al., Subm)

4. CONCLUSIONS



- The contribution per coupled module to MHC profitability was evaluated.
- Differences in the annual and monthly mean wave power availability in the selected sites. PAN 87% > than in PST.
- La Serena has a lower mean inter- and intra-annual variability in electricity produced by the WECs and OWT than Ensenada.
- The same individual WECs generate different performances and mean annual electricity at the two sites analyzed. The PEL is 120% > in Ensenada than in La Serena, while the WD is 200% > in La Serena.
- Hybridization has allowed the required electricity consumption. The DH varied between scenarios, with the PEL-OWT system requiring less hybridization than the WD-OWT system.
- The results highlight the profitability benefits of a blue economy framework. The seaweed aquaculture module fosters profitability in all scenarios. Higher returns than households, higher in La Serena than in Ensenada.
- The analysis highlights the potential benefits of using batteries for energy storage and the value of green hydrogen as an energy source. Battery-powered aquaculture produces the highest NPV and IRR

CONTACTS



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¡THANK YOU FOR YOUR ATTENTION!



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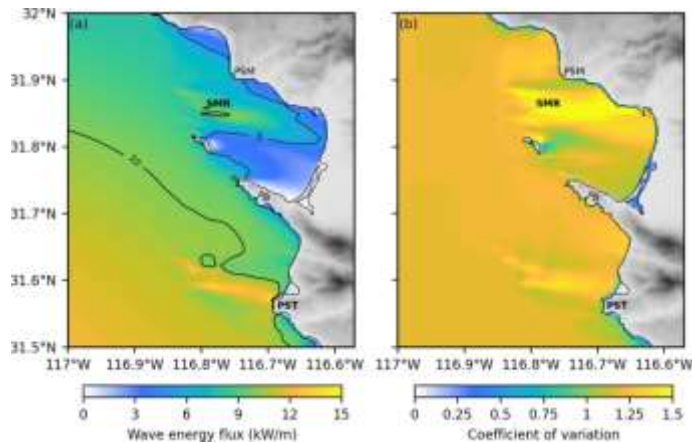
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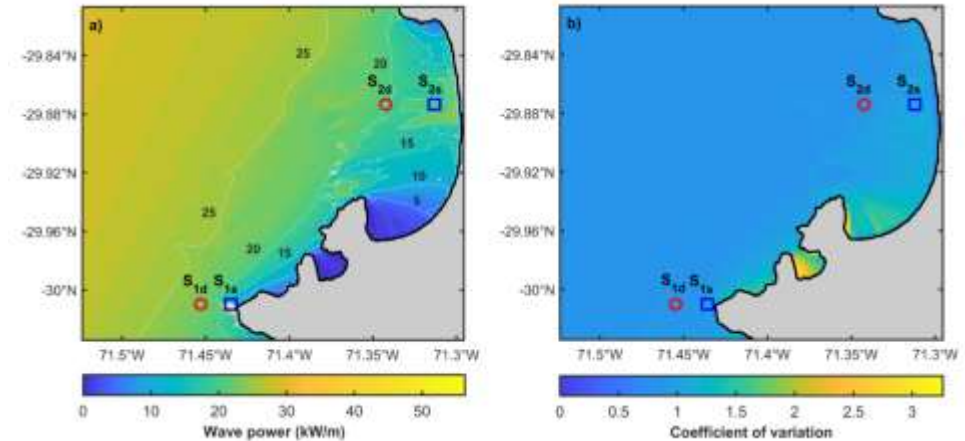
Mean available wave power (a) and coefficient of variation (b)

Ensenada (Mexico)



(Gorr-Pozzi et al., 2021)

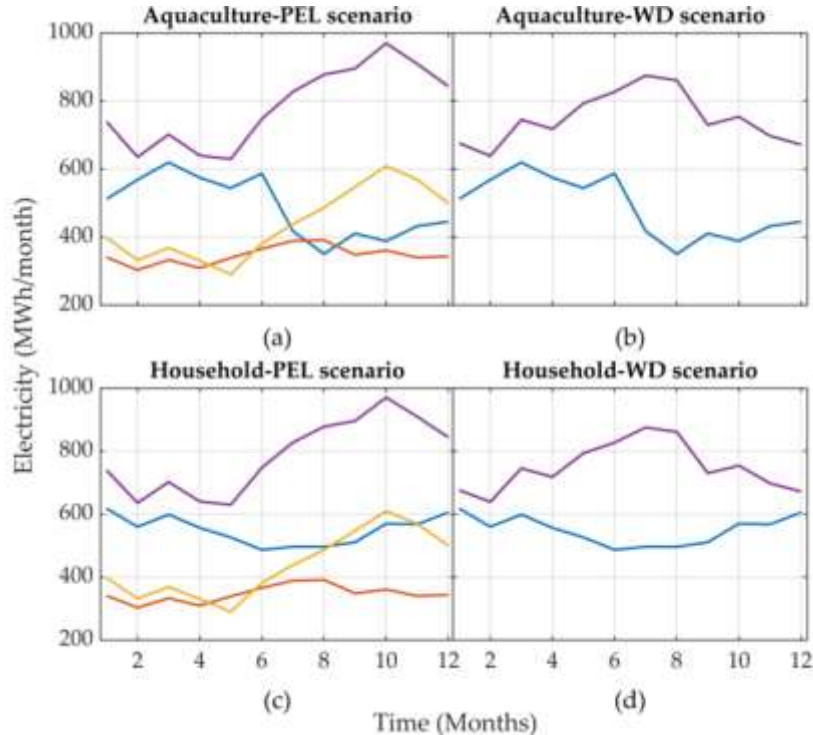
La Serena (Chile)



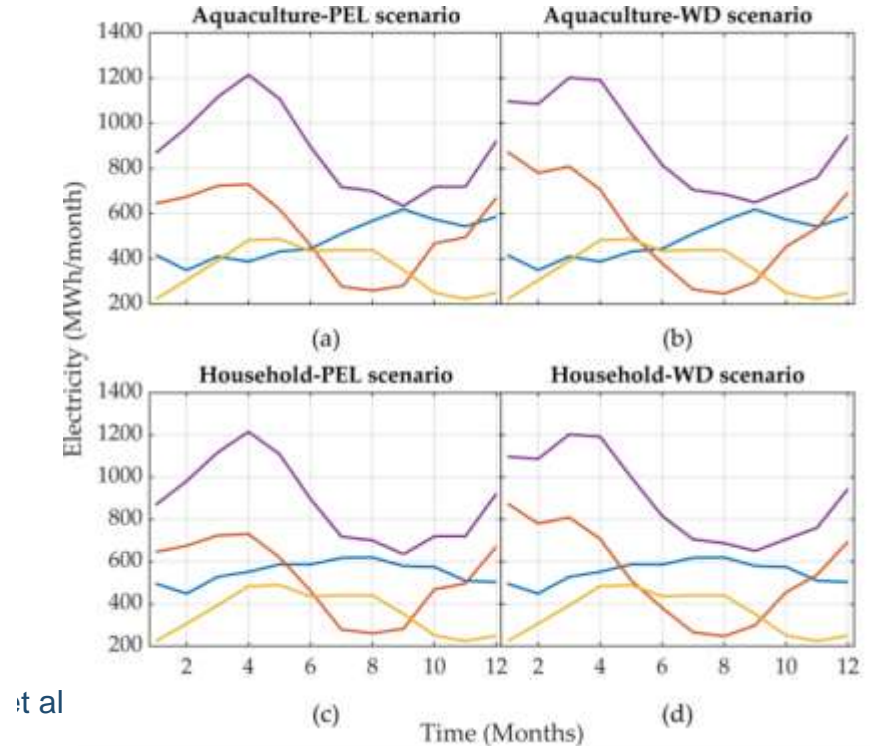
(Gorr-Pozzi et al., 2021)

Energy balance. Electricity generation-consumption profiles

La Serena



Ensenada



(Gorr-Pozzi et al., Subm)

