Politecnico di Torino

MARINE OFFSHORE RENEWABLE ENERGY LAB

umerc + OREC 2025

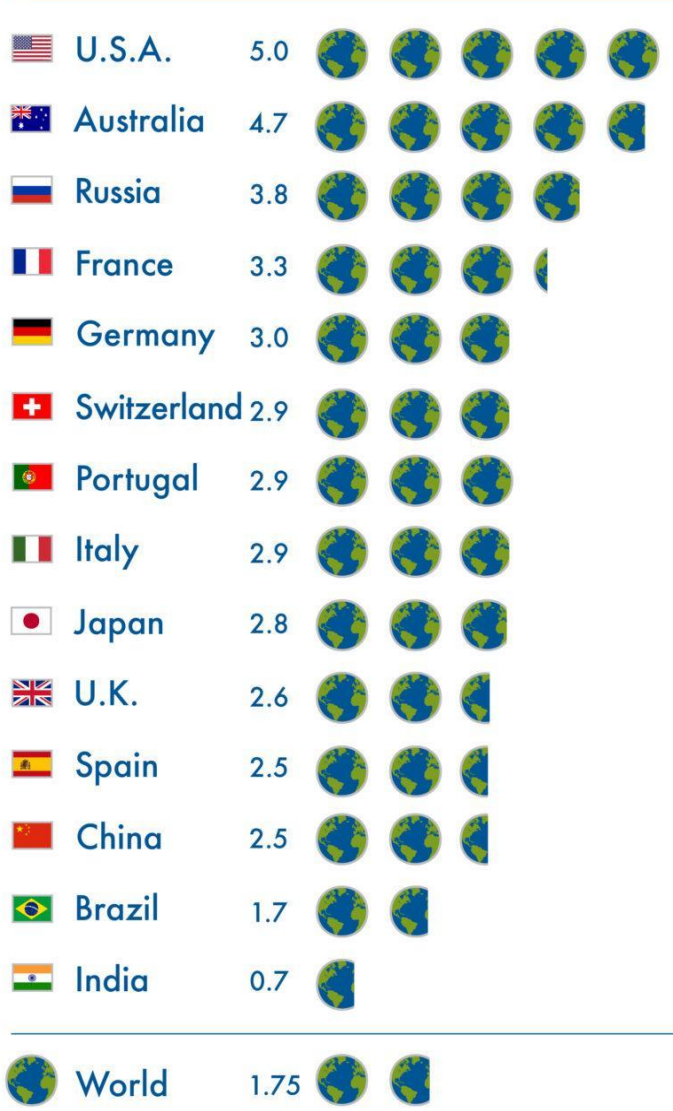
Exploring **techno-economically** viable markets for **wave energy** harnessing in arid coastal regions of Latin America

Dr. Emiliano Gorr-Pozzi, Dr. Manuel Corrales-Gonzalez, Dr. Jorge Olmedo-González,
Ms. Diego Selman-Caro, Dr. Giuseppe Giorgi

12-14 Aug 2025, Corvallis, Oregon

Motivation

How many Earths would we need
if everyone lived like U.S.A. residents?



[Global Footprint Network, 2024]

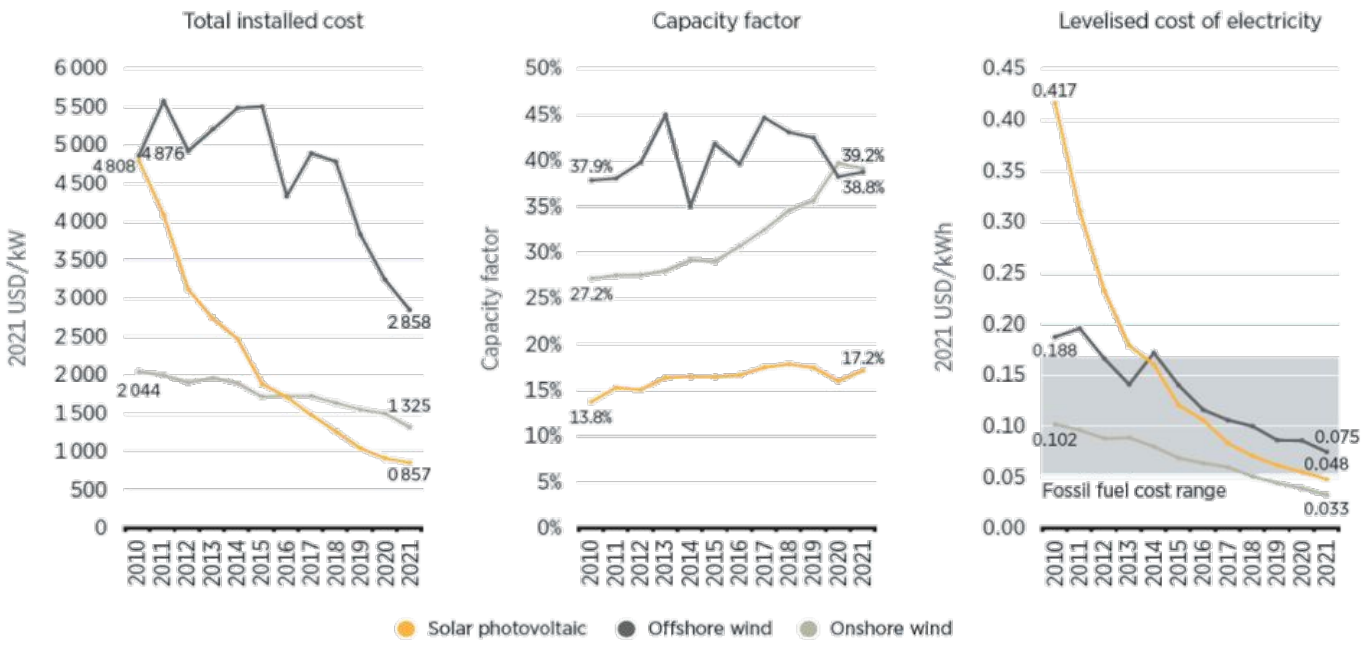
1. Introduction

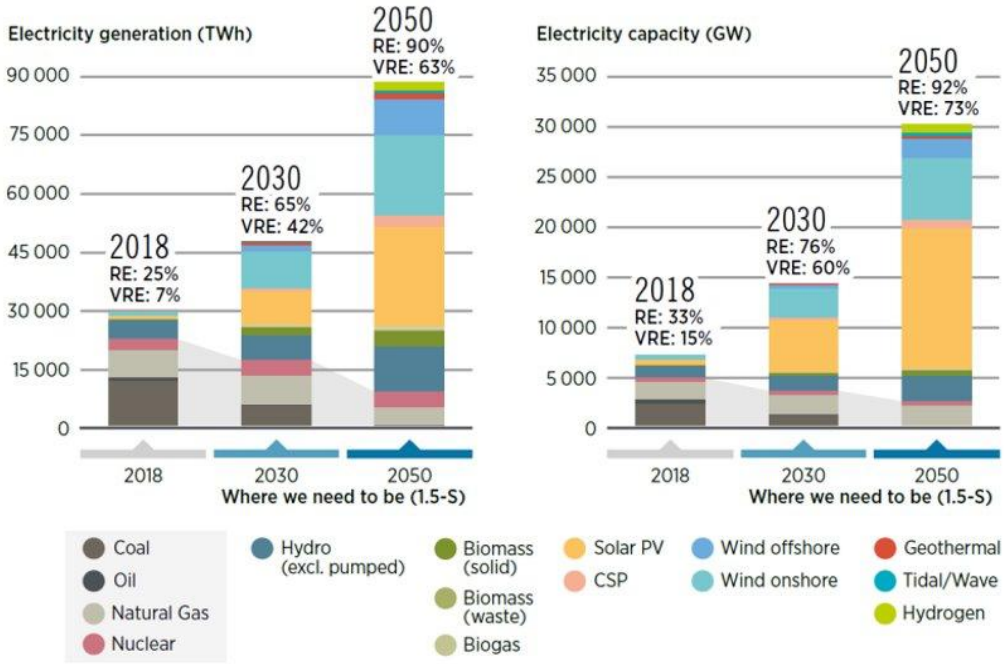
(UNGA, 2015)

(UN, 2016)

United Nations Climate Change
Global Climate Action

(UNFCCC, 2023)

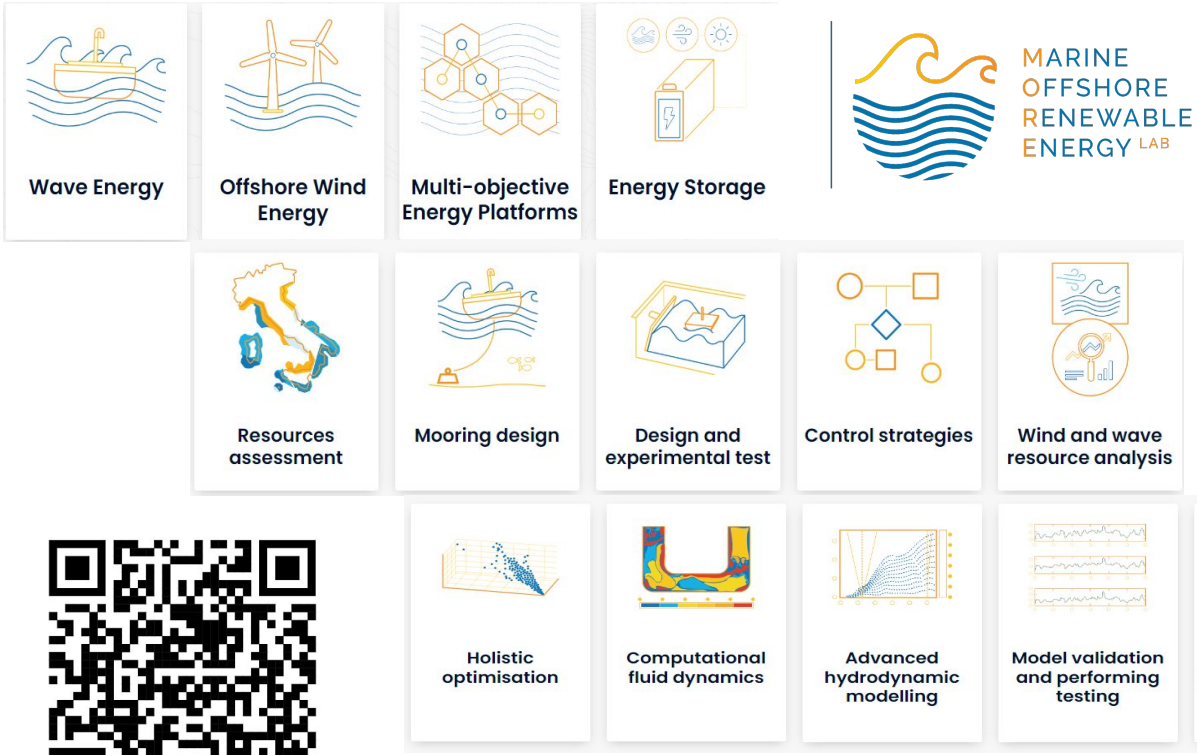




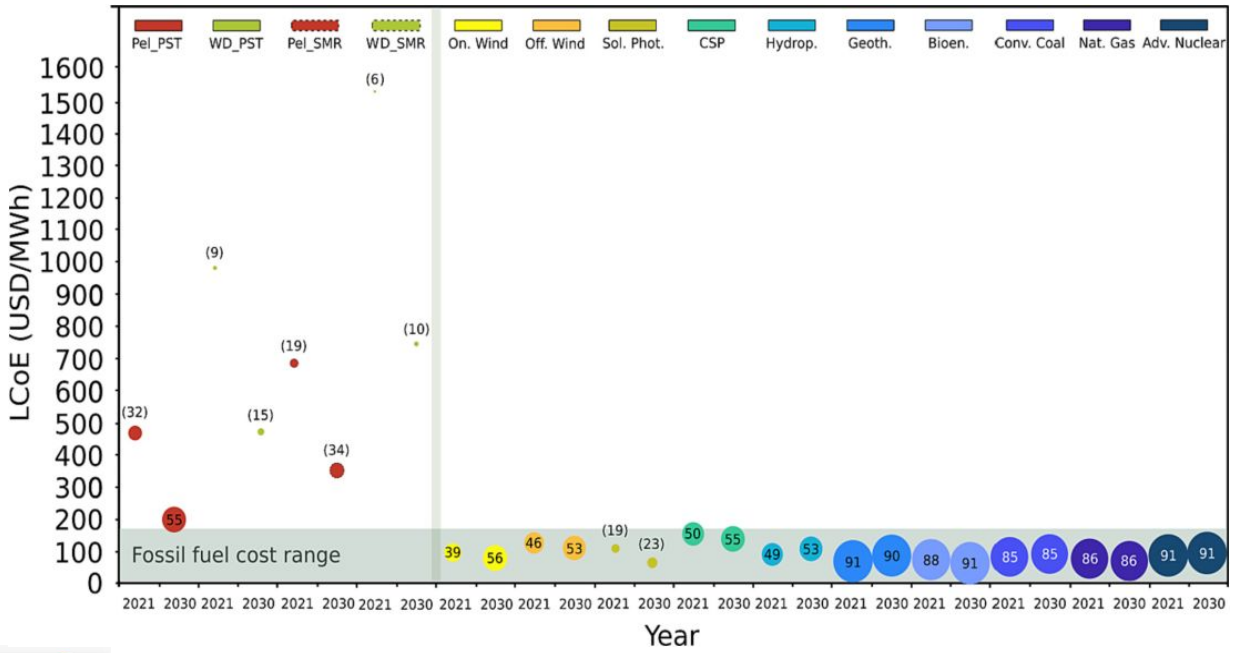
(IRENA, 2022)

1. Introduction

Skills for Offshore and Maritime research



LCoE and Cf of WEC vs. Energy Market to 2030

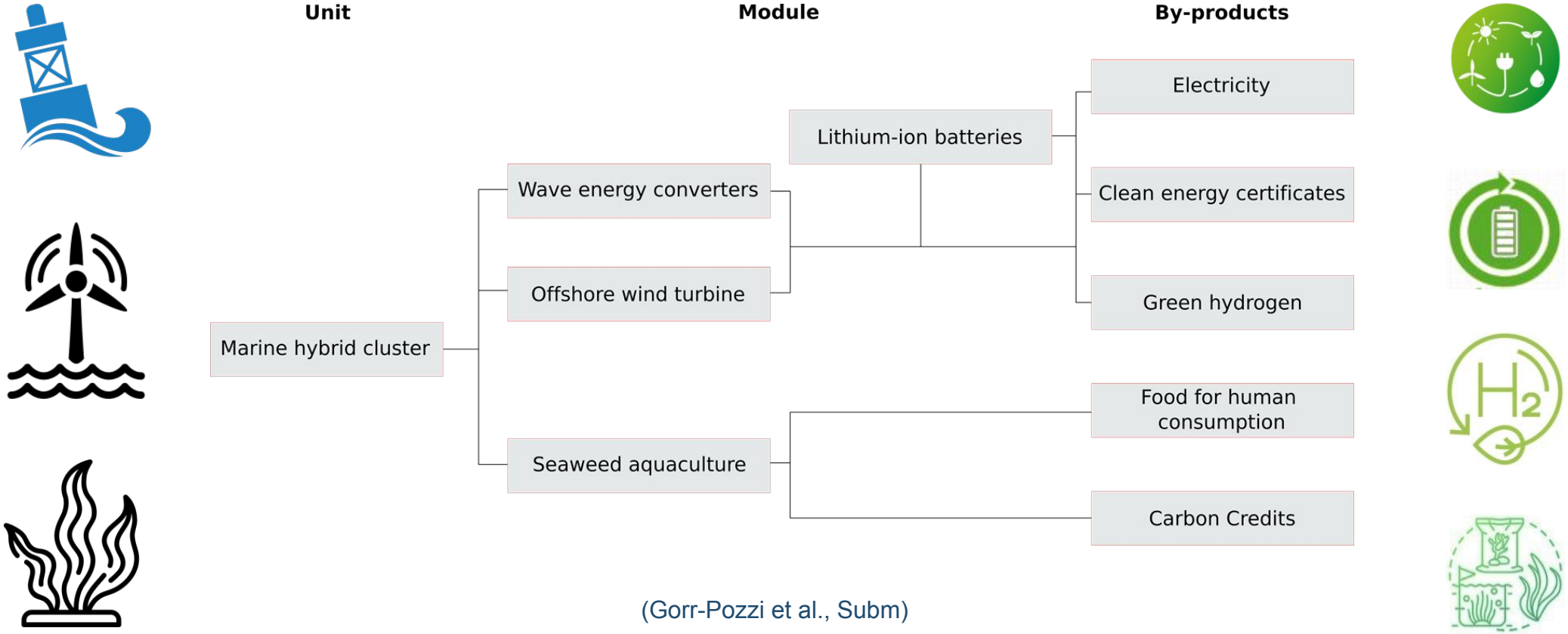


[Gorr-Pozzi et al., 2023]

1. Introduction

Goal

Evaluate the **techno-economic feasibility** of **Marine Hybrid Clusters** coupled with a **wave-offshore wind renewables** 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. Methodology

Technical data

- Wave power availability & harvested
  - $P = \rho g \int\int c_g(f) E(f,\theta) df d\theta$
  - $HP = \sum\sum HR(H_s, T_p) \cdot PWEC(H_s, T_p)$
- Offshore wind power availability & harvested
  - $P_w = \frac{1}{2}\rho U^3$
  - $P_{w_{ext}} = \sum nC_p$

→ AEP

+

Economic data

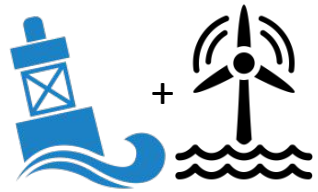
- WECs
- Offshore Wind
- Utility-scale Lithium-ion Battery
- Alkaline Electrolyzer
- Seaweed aquaculture

→ CapEx, OpEx

→ **Marine Hydrid Cluster profitability**

- $LCOE = \frac{CapEx_{t=0} + \sum_{t=1}^{n} \frac{OpEx_n}{(1+r)^n}}{\sum_{t=1}^{n} \frac{AEP_n}{(1+r)^n}}$
- $NPV = -C_0 + \sum_{1}^{n} \frac{F_n}{(1+r)^n}$
- $ROI = \frac{R_n - C_n}{C_n}$
- $PP = \frac{C_0}{C_n}$

WEC selection
(Gorr-Pozzi etal., 2021)
(Selman-Caro etal., 2024)
OWT selection
(NREL, 2023). 3.3 MW

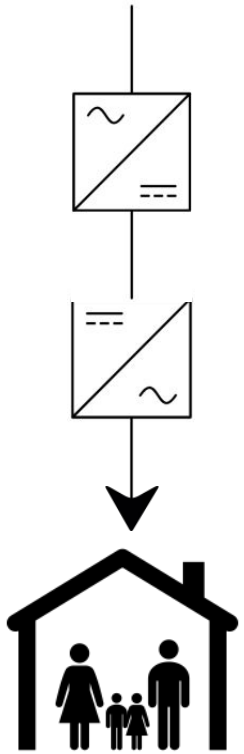


Marine Cluster Sizing
- 875 MWh Production

Microgrid interconnected electrical scheme

- 5,000 Households
- 68 ha Aquaculture
- 620 MWh Consumption

(Blue Evolution, 2022)



(INEGI, 2023)

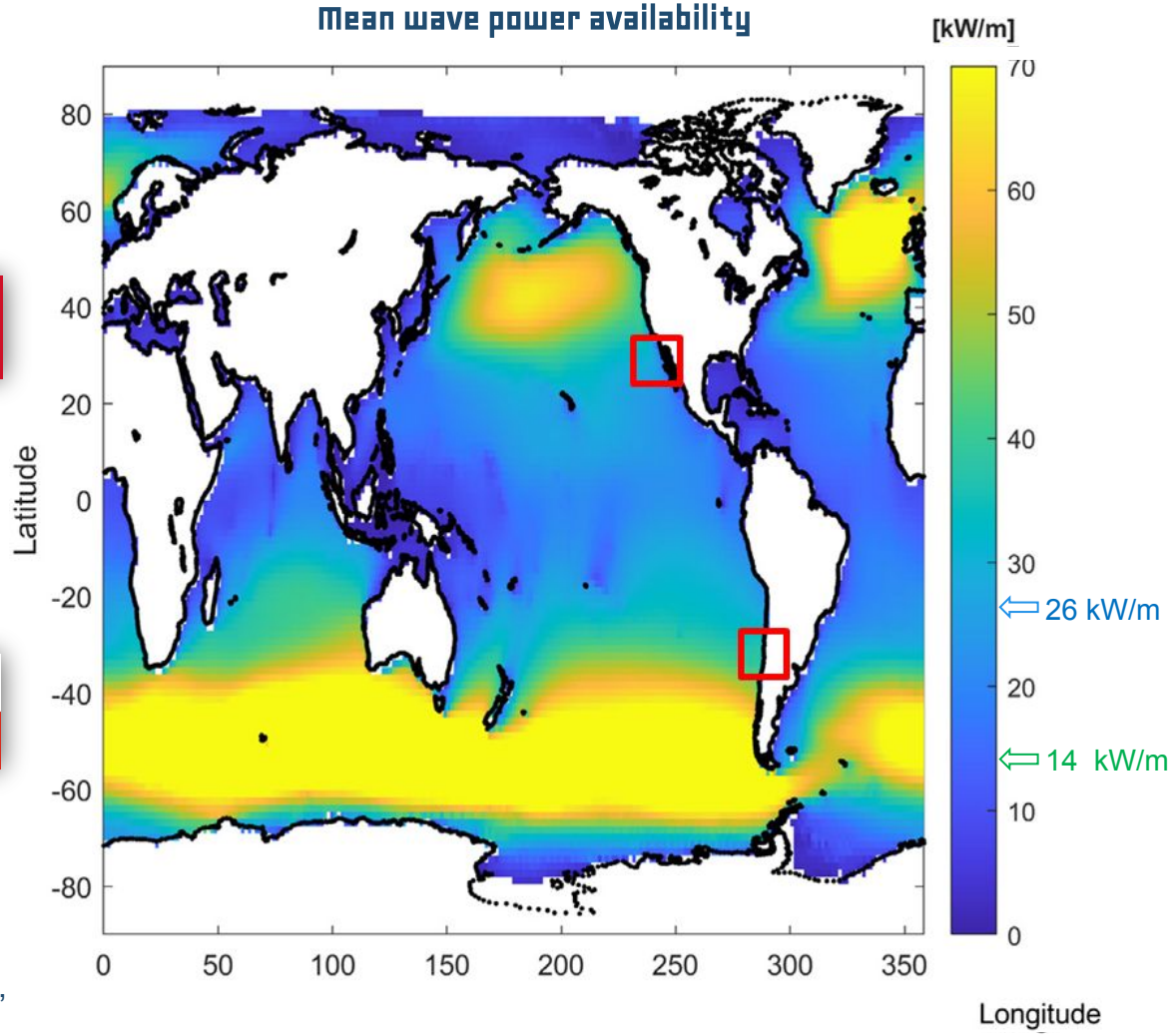
2. Methodology

Field site. Ensenada [México] and La Serena [Chile]

31° N

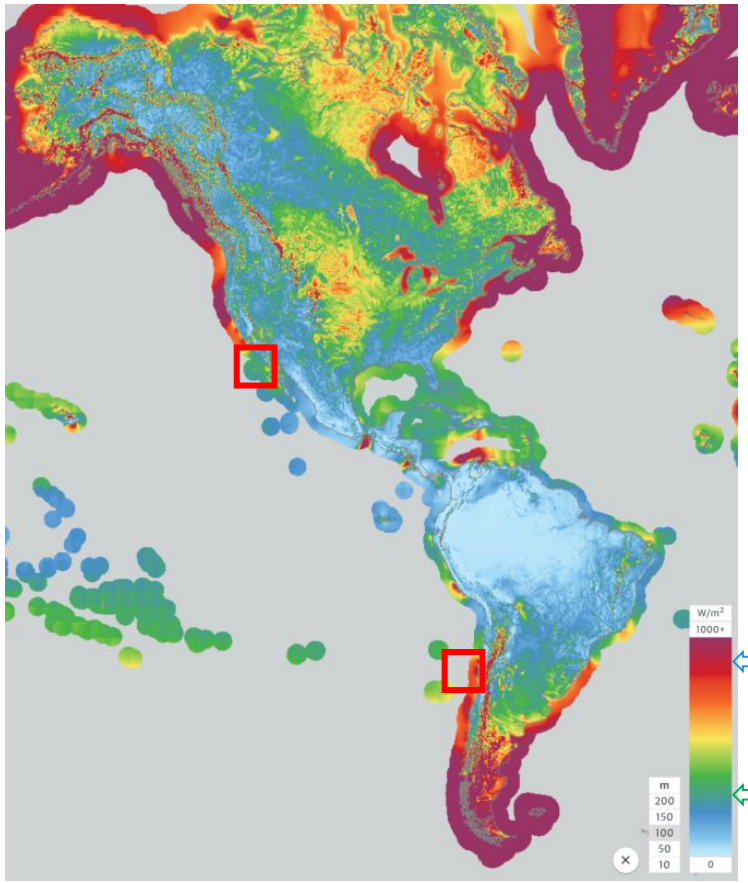
-30° N

Mean wave power availability



(Meneses et al., 2024)

Mean offshore wind power density



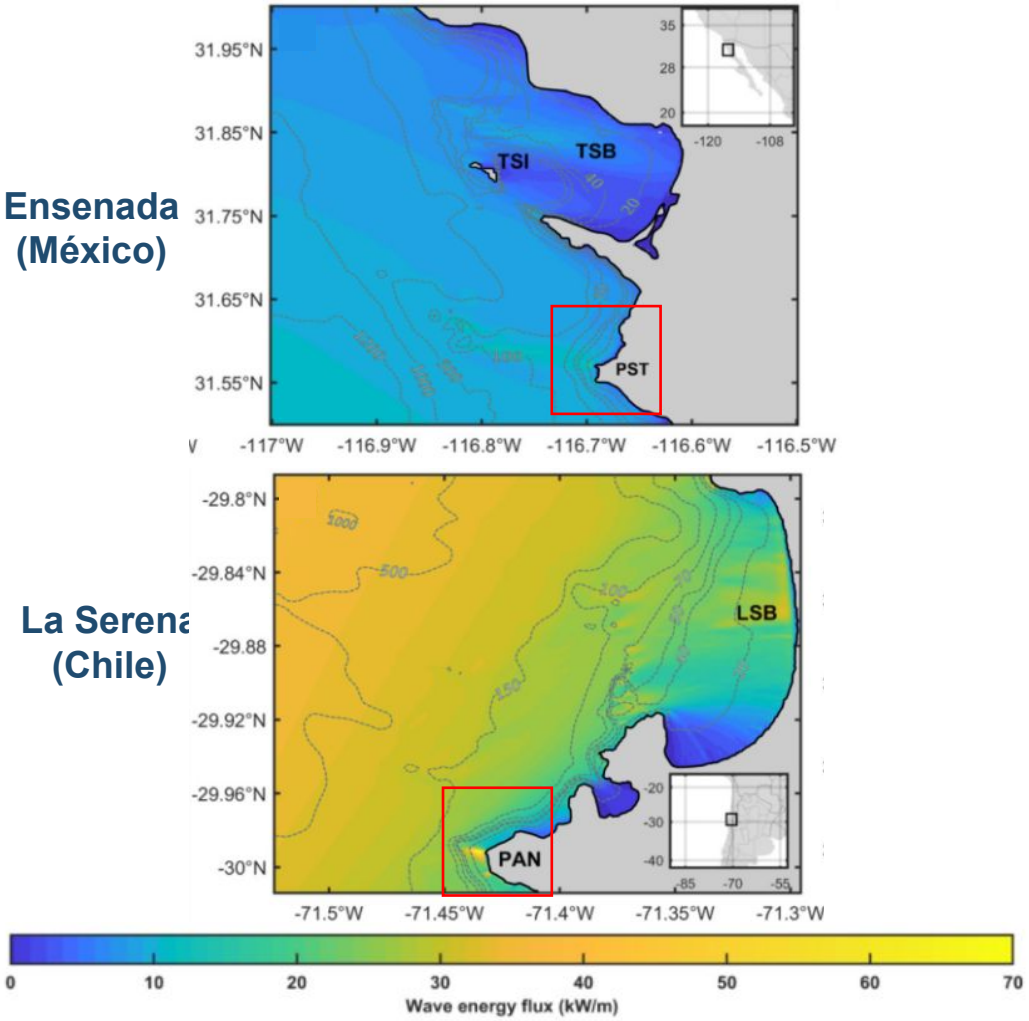
(GWA, 2024)

3. Results

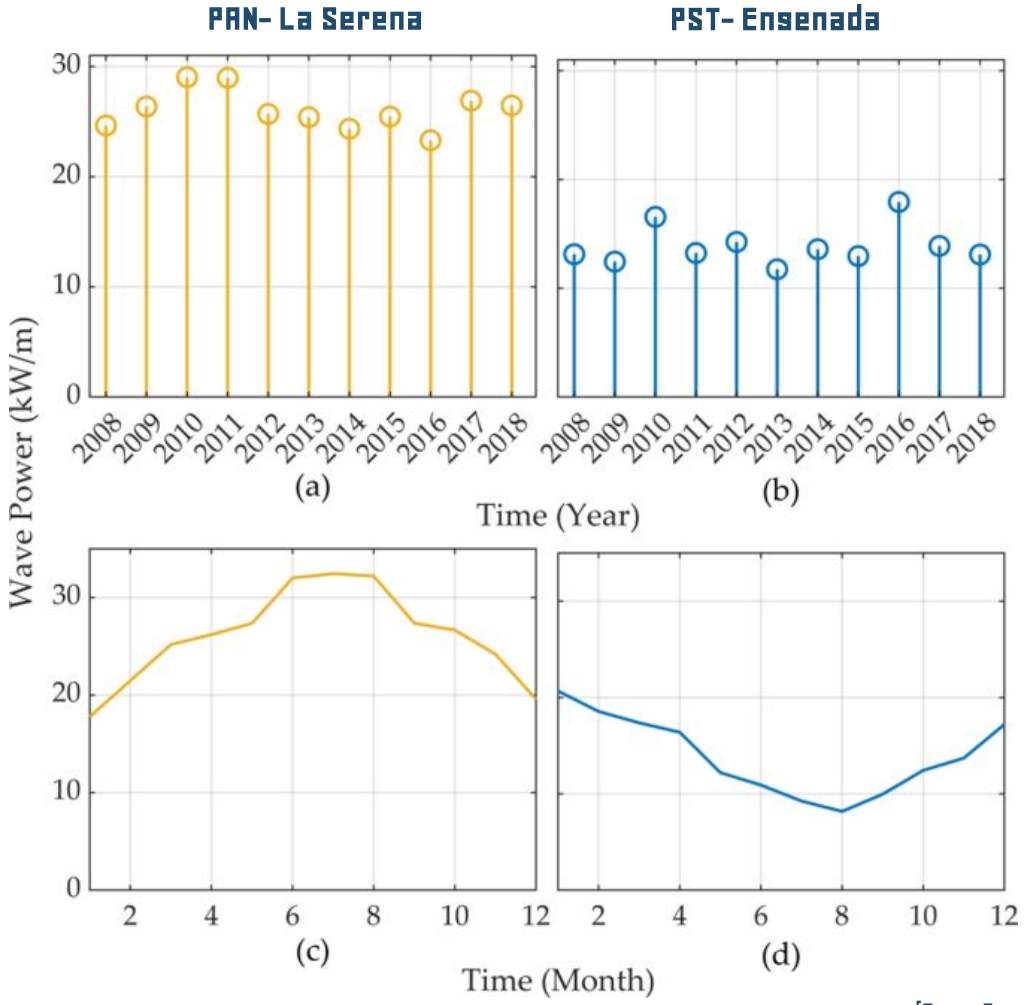
Mean wave power availability and variability

Ensenada (México)

La Serena (Chile)



(Gorr-Pozzi et al., Subm)



[Gorr-Pozzi et al., 2021]

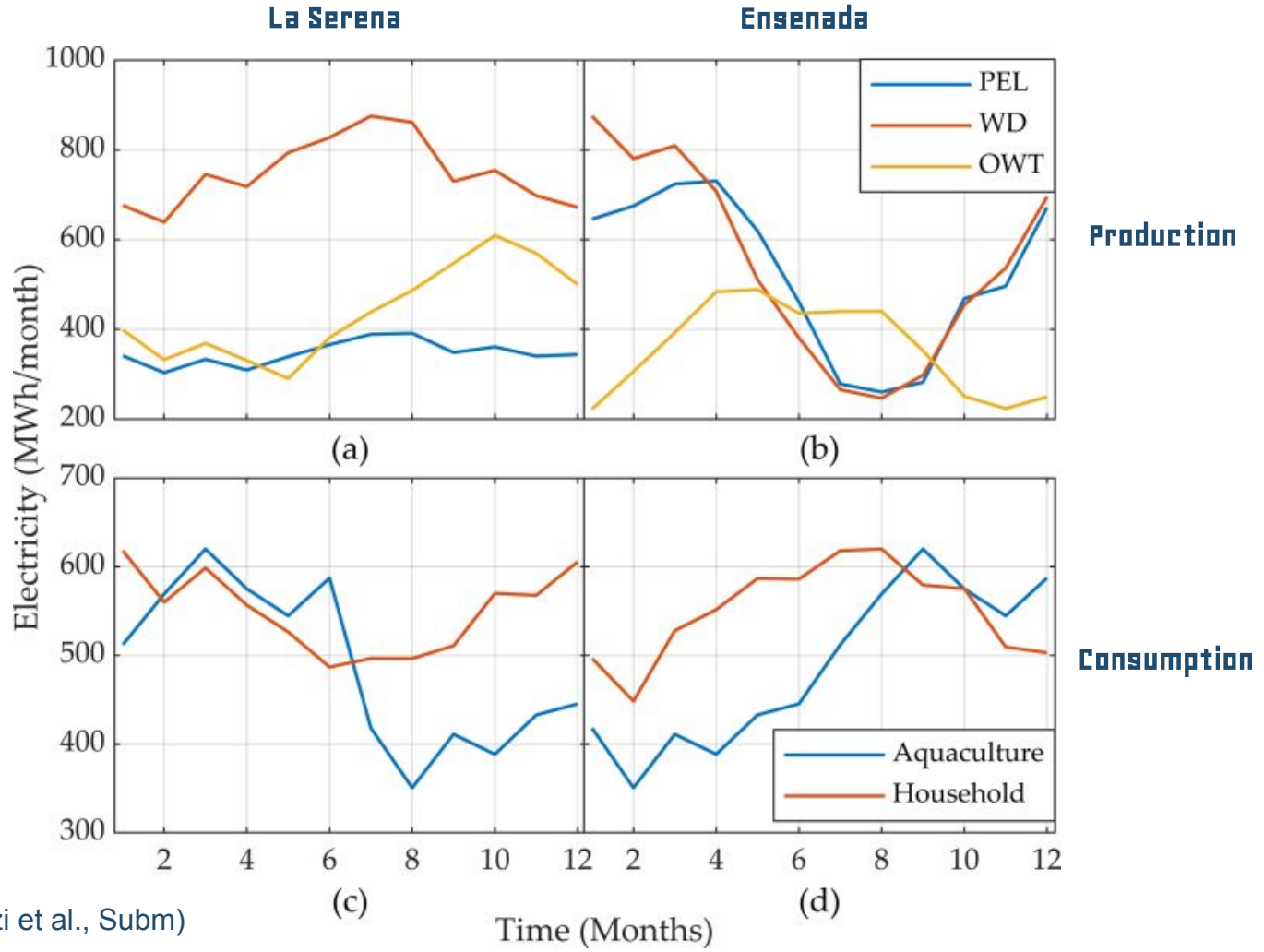
[Selman-Caro et al., 2024]

3. Results

Energy balance. Electricity generation-consumption profiles

TABLE II
DESIGN PARAMETERS FOR MARINE CLUSTER SCENARIOS

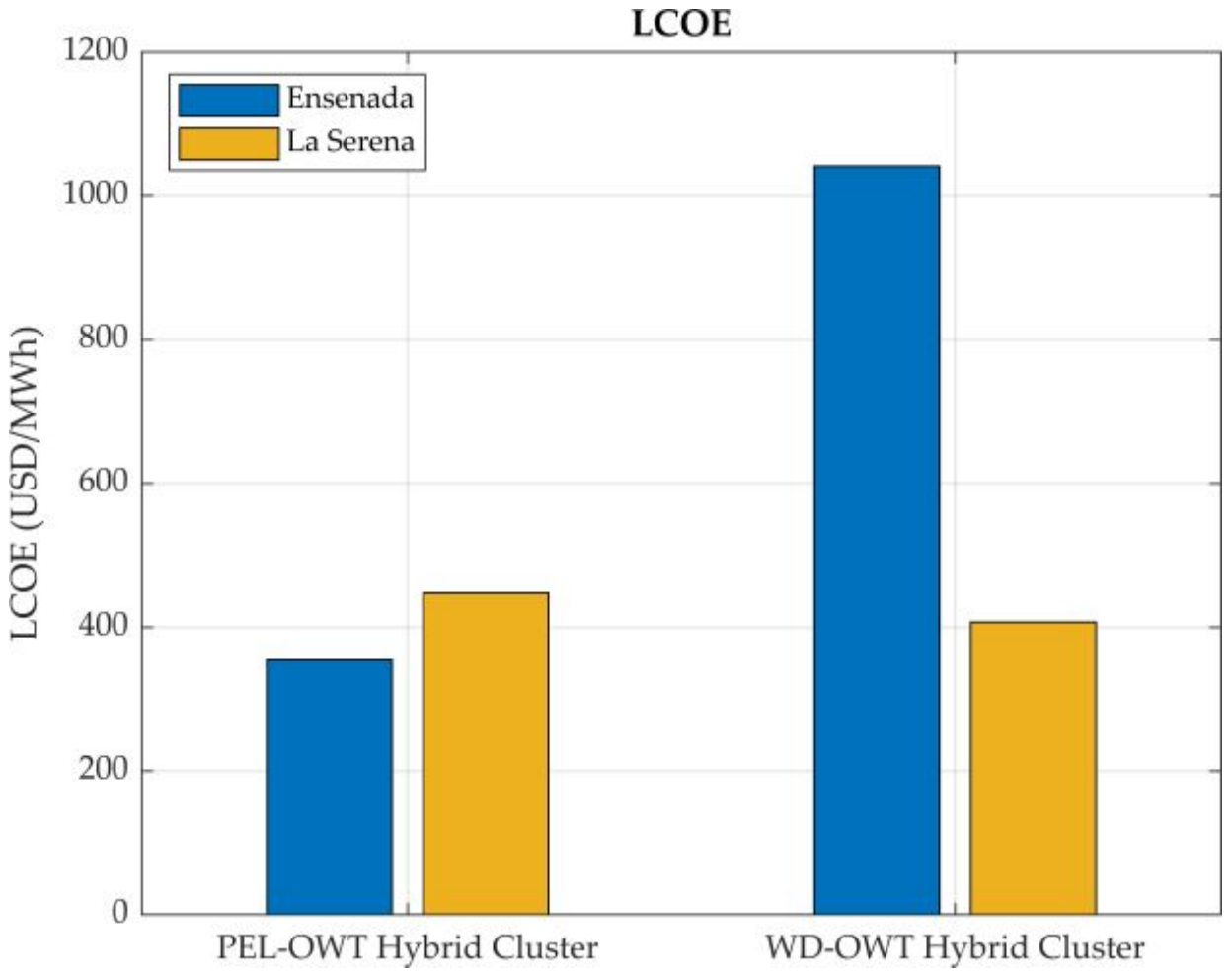
Scenarios	Hybridization	Number of WEC	Number of OWT
La Serena-PEL-OWT Aquaculture La Serena PEL-OWT Household	44.23%	6	1
La Serena WD Aquaculture La Serena WD Household	N/A	1	0
Ensenada PEL-OWT Aquaculture Ensenada PEL-OWT Household	59.56%	5	1
Ensenada WD-OWT Aquaculture Ensenada WD-OWT Household	60.48%	3	1



(Gorr-Pozzi et al., Subm)

3. Results

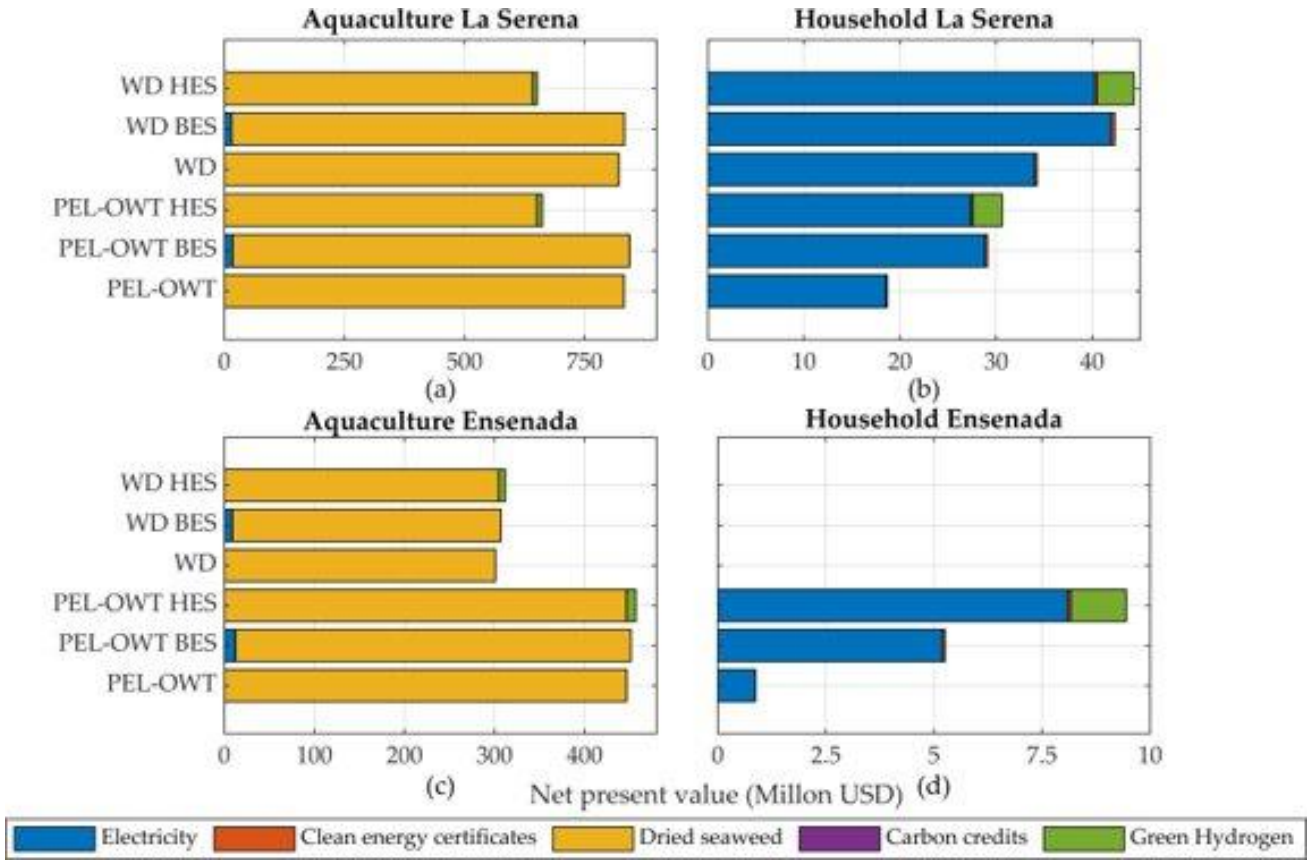
Marine Hybrid Clusters profitability

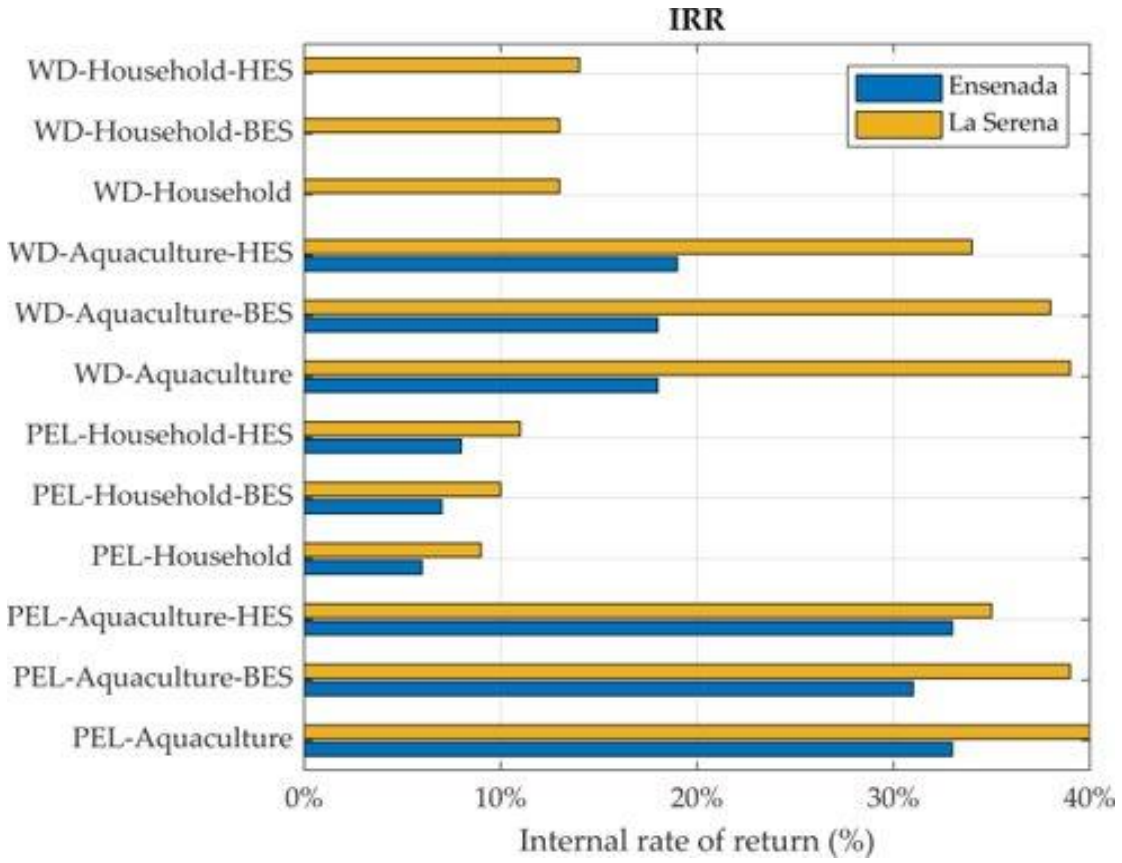


(Gorr-Pozzi et al., Subm)

3. Results

Marine Hybrid Clusters profitability





(Gorr-Pozzi et al., Subm)

4. Conclusions

- The contribution per coupled unit to the Marine Hybrid Cluster **profitability** was evaluated.

- The geolocation and proximity to the extratropical generation zones of the Pacific generate differences in the **availability** of annual and monthly mean **wave power** in the selected sites. More constant Wave Power resource and lower mean intra-annual **variability** in La Serena than Ensenada (lower inter-annual variability).

- The same individual classes of **WECs** generate different **yields** at the two sites analyzed. The PEL device produces 120% more mean annual electricity in Ensenada. WD generates 200% more in La Serena. The integration of OWT into the MHC allowed the WECs to contribute significantly to cover the electricity demand. **Hybridization of WEC and OWT** systems was more critical in Ensenada, where higher variability in wave energy required greater integration.

- Profitability benefits of a **blue economy** framework. The **seaweed aquaculture** module fosters profitability in all scenarios. Regardless of the WEC nature used and the energy surplus. Higher returns than households, higher in La Serena than Ensenada.

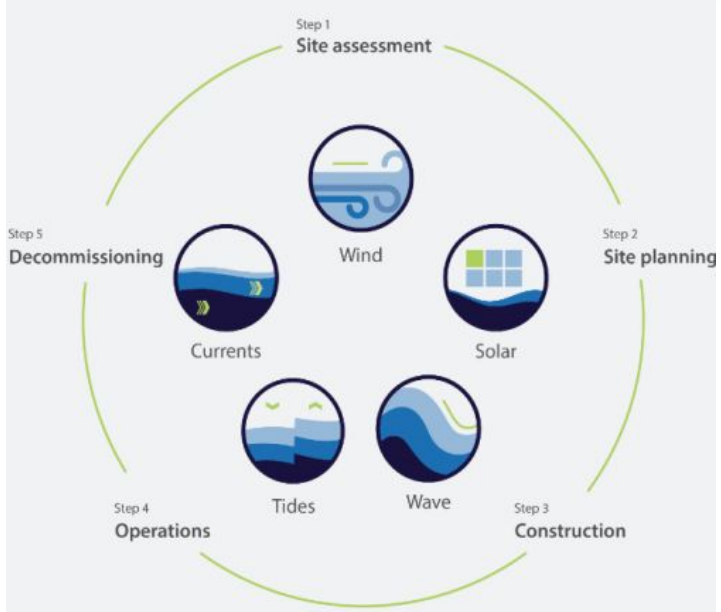
- It is necessary to continue with the innovation and development of **new generations of cost-effective WEC** s adapted to the local conditions. Optimization WEC, response/control strategies, Costs, and considering **social environmental** aspects.

Future works

BLUE-X

BLUE ENERGY OFFSHORE INSTALLATION ACCELERATOR

EUSPA
European Union Agency for the Space Programme



Future works

International Cooperation in Research

Energy transition

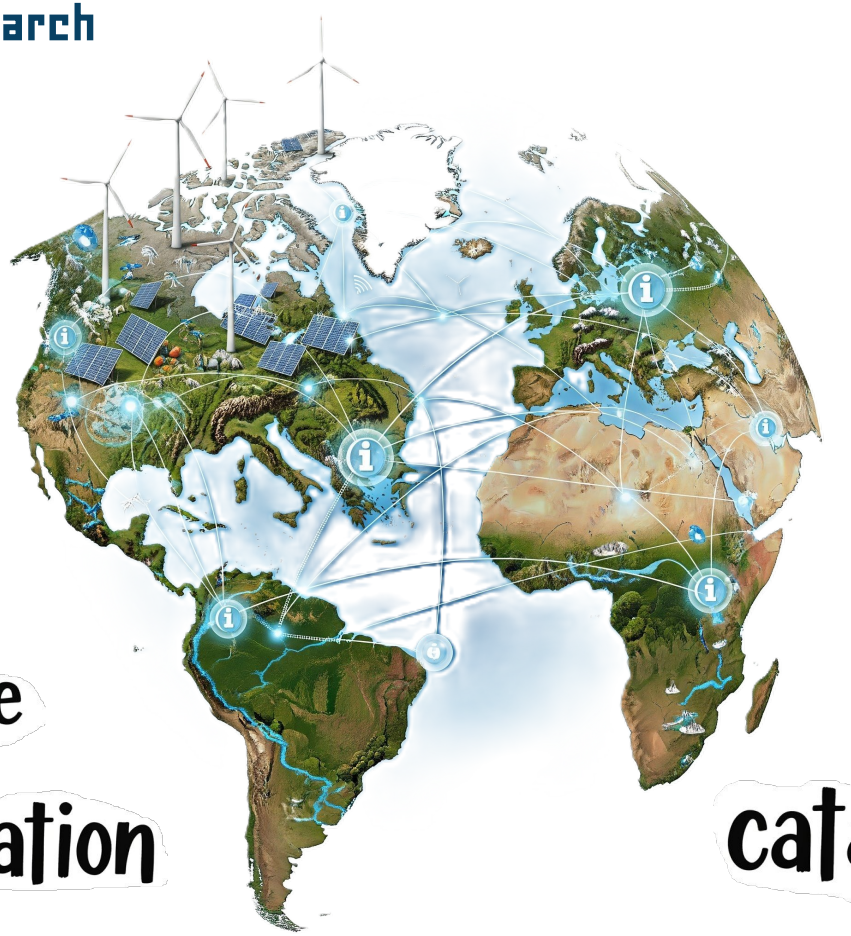
Blue economy

scale-up

supply chain

Infrastucture

New Market creation



Opportunities

Innovation

Knowledge transfer

road maps

regulatiory framewrks

catapult ORE markets

PAMEC.Energy Association

REMAR

CYTED

EUSPA European Union Agency for the Space Programme

Thank you for your attention!

Dr. Emiliano Gorr-Pozzi
[emiliano.gorr@polito.it]