

Installation and Maintenance of Offshore Renewable Energy Technologies

Challenges for Latin America

Dr.-Ing. Gonzalo Tampier Brockhaus
Universidad Austral de Chile / MERIC



A REALITY IN MORE AND MORE PARTS OF THE WORLD. AN OPPORTUNITY FOR LATIN AMERICA



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Conclusions and
projections

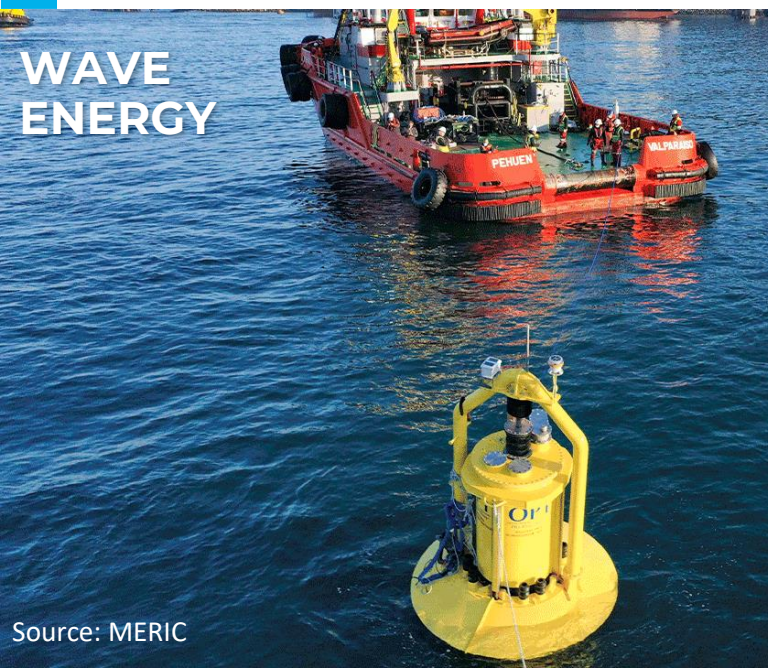


About us



CEH UACH **50** AÑOS
CANAL DE ENSAYOS HIDRODINÁMICOS

Offshore Renewable Energy (ORE)



WAVE ENERGY



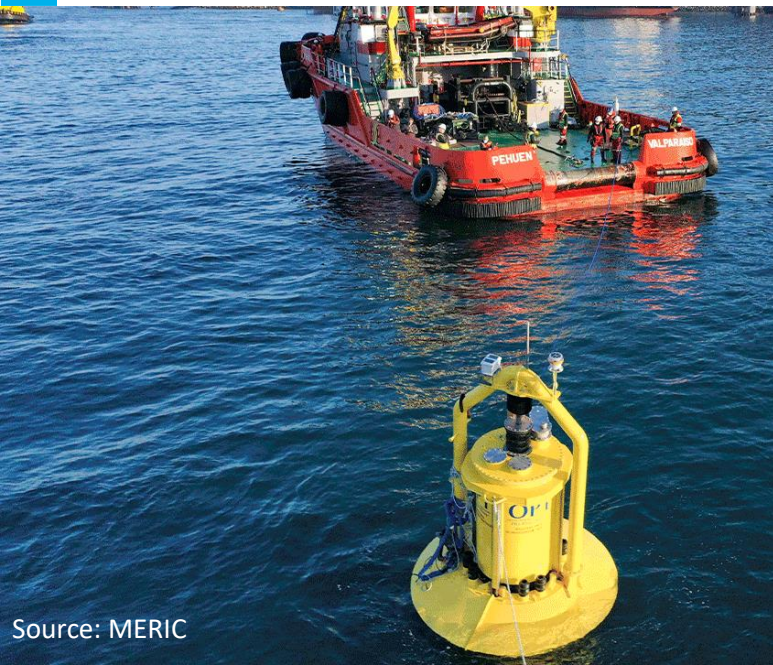
TIDAL ENERGY



FIXED and FLOATING OFFSHORE WIND



ORE Market



Source: MERIC



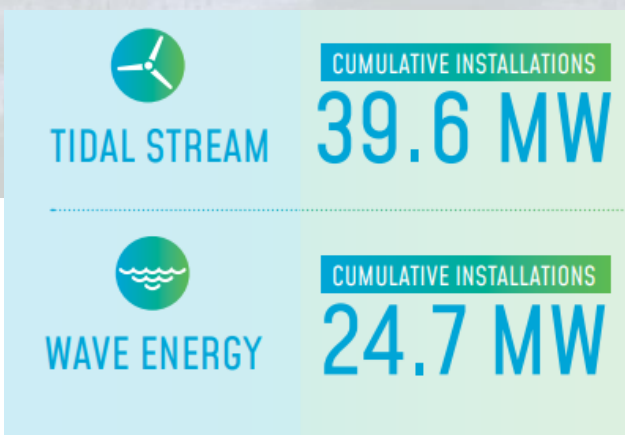
Source: Sustainable Marine



Source: NREL

ORE Market:

Installed Power



Source: <https://www.oceanenergy-europe.eu> 2021

Wave and Tidal Energy

LCOE

TIDAL	
2022	310 USD/MWh
2030	139 USD/MWh
WAVE	
2022	850 USD/MWh
2030	~300 USD/MWh

Source: ORE Catapult 2022 / OES 2015

Challenges

- Cost reduction
- Scalability
- Survivability
- Maintainability
- Materials
- Control

Wave and Tidal technologies are still in an early development stage, with important R&D requirements. **No reliable growth estimates**

ORE Market:

Offshore Wind Energy

Installed Capacity

**Bottom-fixed
54.9 GW**

**Floating
~200 MW**

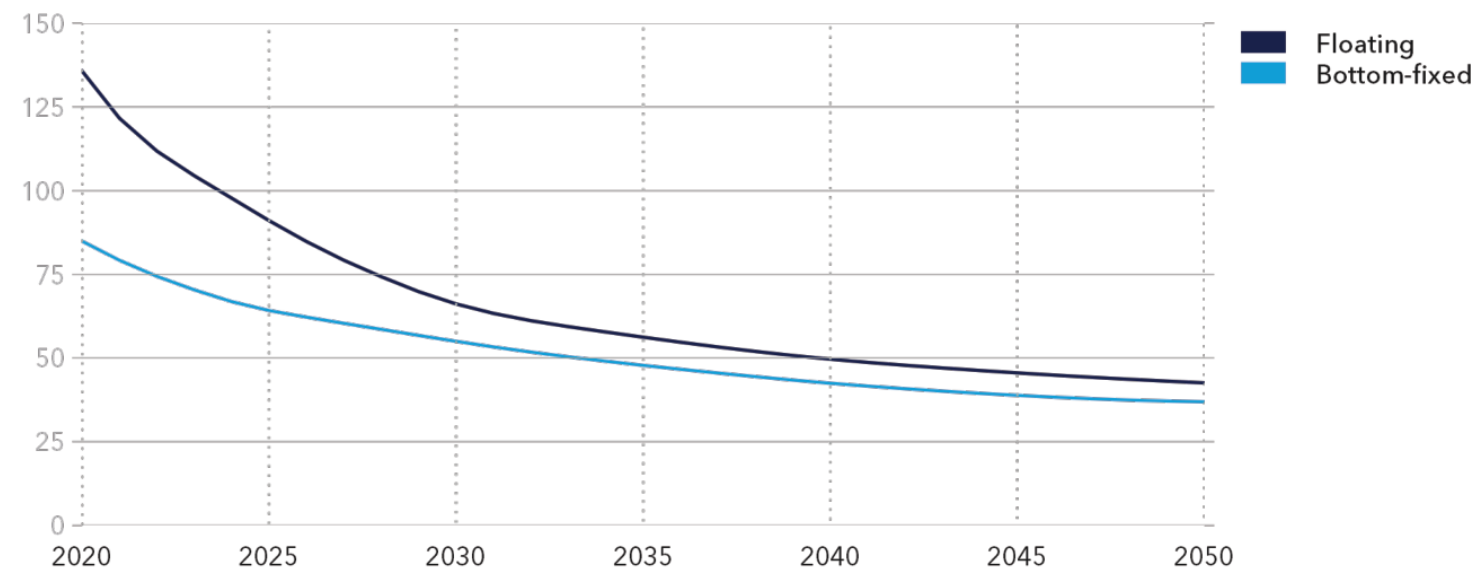
Source:



LCOE

Average Levelized Cost of Energy (LCOE) of offshore wind

Units: €/MWh



©DNV GL 2020

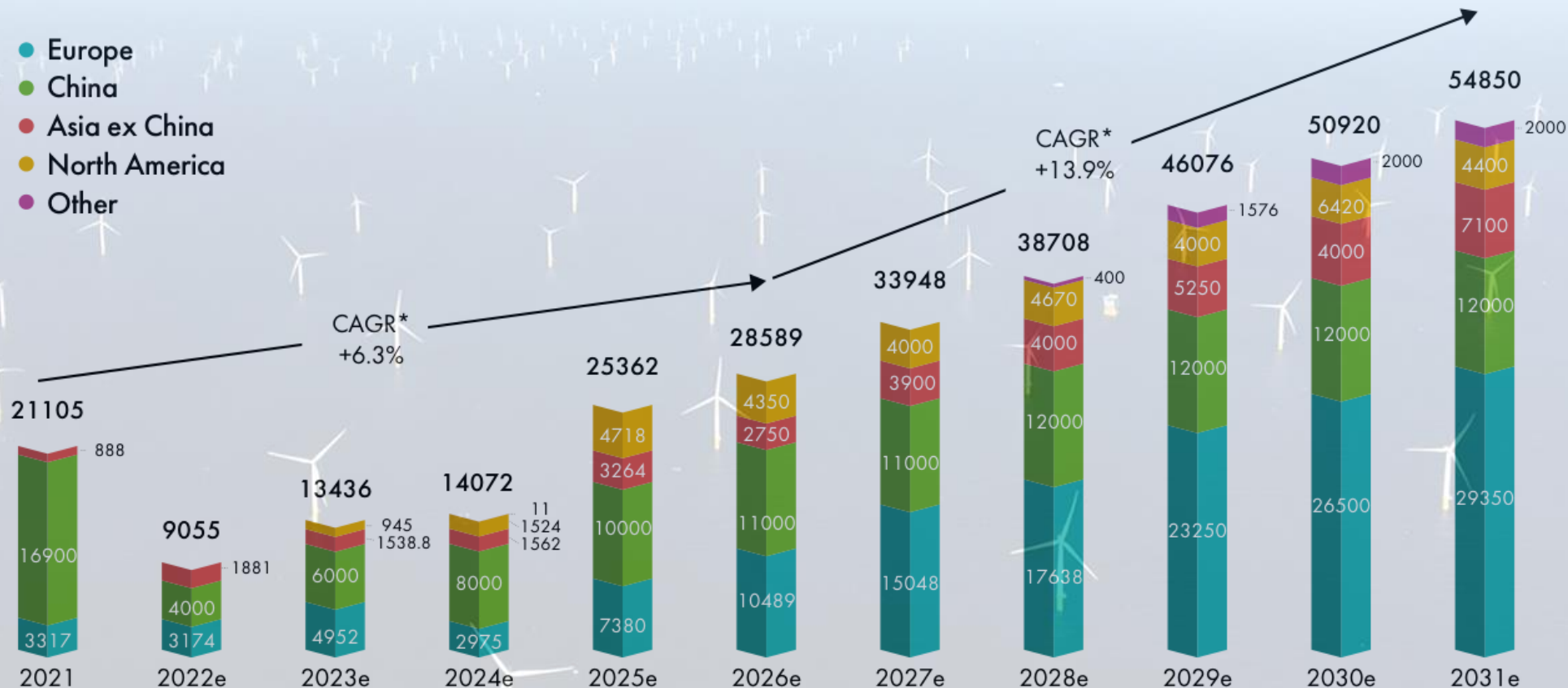
Source: DNV 2020

Fixed offshore wind is already an industry, transferring its experience and technology to the emerging floating wind industry

ORE Market: Offshore Wind (Fixed)

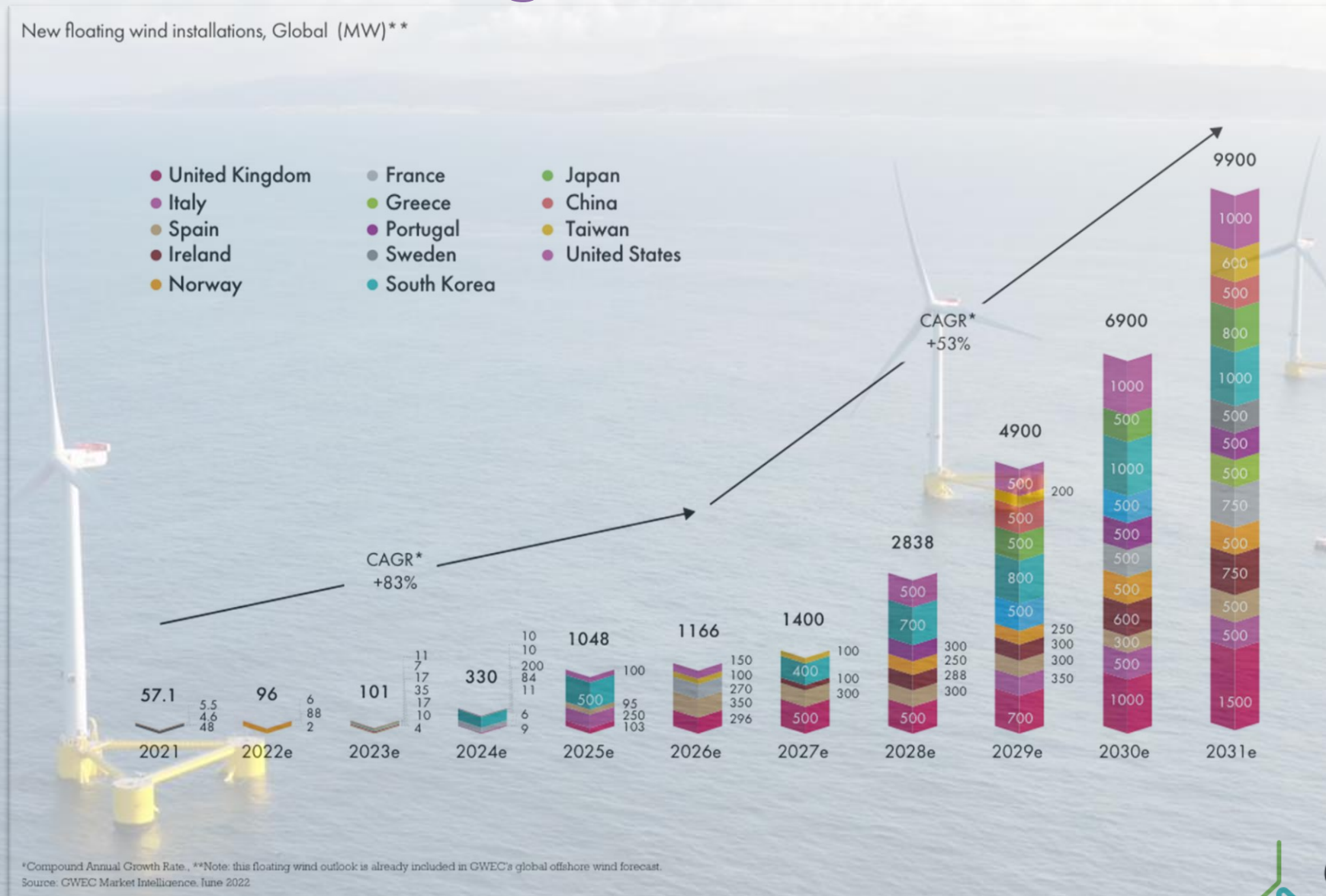
New offshore installations, global (MW)

- Europe
- China
- Asia ex China
- North America
- Other



*Compound Annual Growth Rate.
Source: GWEC Market Intelligence, June 2022

ORE Market: Floating Wind



700 GW

Fixed Offshore Wind Global Project
Pipeline

120 GW

Floating Offshore Wind Global Project
Pipeline

Brent spot
\$84.61 ▼ -1.54%

Brent futures (1 mo)
\$84.56 ▼ -1.48%

WTI spot
\$78.64 ▼ -1.57%

WTI futures (1 mo)
\$78.46 ▼ -1.53%

UK Nat Gas (1 mo)
107.75p ▼ -4.80%



BlueFloat unveils 1.7GW Oz floater

1725MW Eastern Rise project will be located off the Hunter region of New South Wales

28 February 2023 Offshore Wind

[Image: BlueFloat]

ENTREVISTA

Colombia y Brasil lideran el mercado eólico marino regional

Bnamericas

Publicado: viernes, 04 noviembre, 2022

N



Chinese offshore wind industry leaves the pack behind in 2022

China accounted for 72% of the 9.4 gigawatts in offshore wind projects completed in 2022

20 February 2023 14:07 GMT UPDATED 20 February 2023 16:18 GMT

By Dariusz Snieckus

71 Offshore Wind Applications Now Filed in Brazil, Proposals Total 176.6 GW

December 8, 2022, by Adrijana Buljan

Home > Press corner >

State aid: Commission approves €2.08 billion French measure

Available languages: English

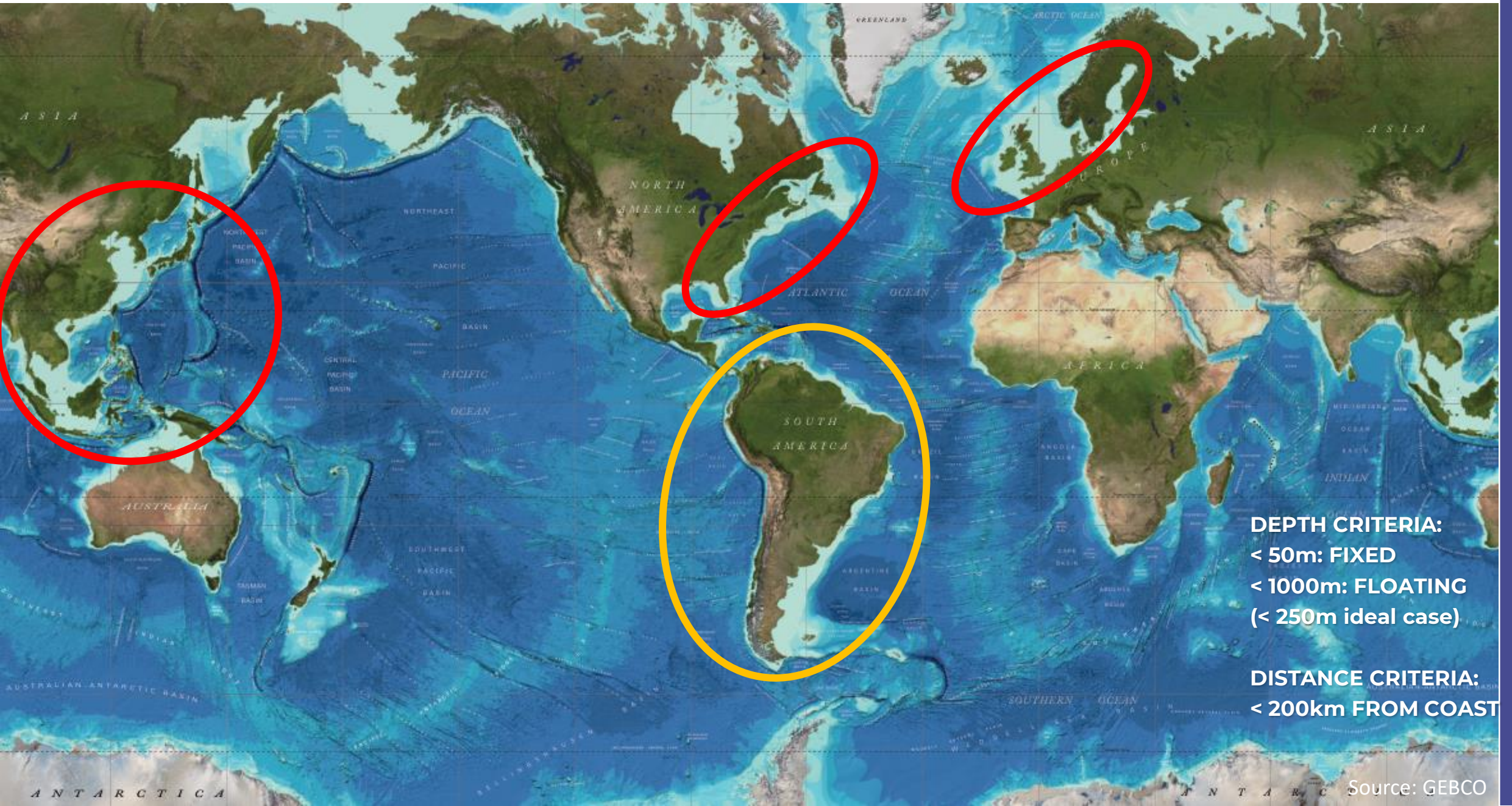
Press release | 13 February 2023 | Brussels

State aid: Commission approves €2.08 billion French measure to support offshore wind energy generation

ORE in Latin America



ARE WE THE NEXT REGION?



DEPTH CRITERIA:

< 50m: FIXED

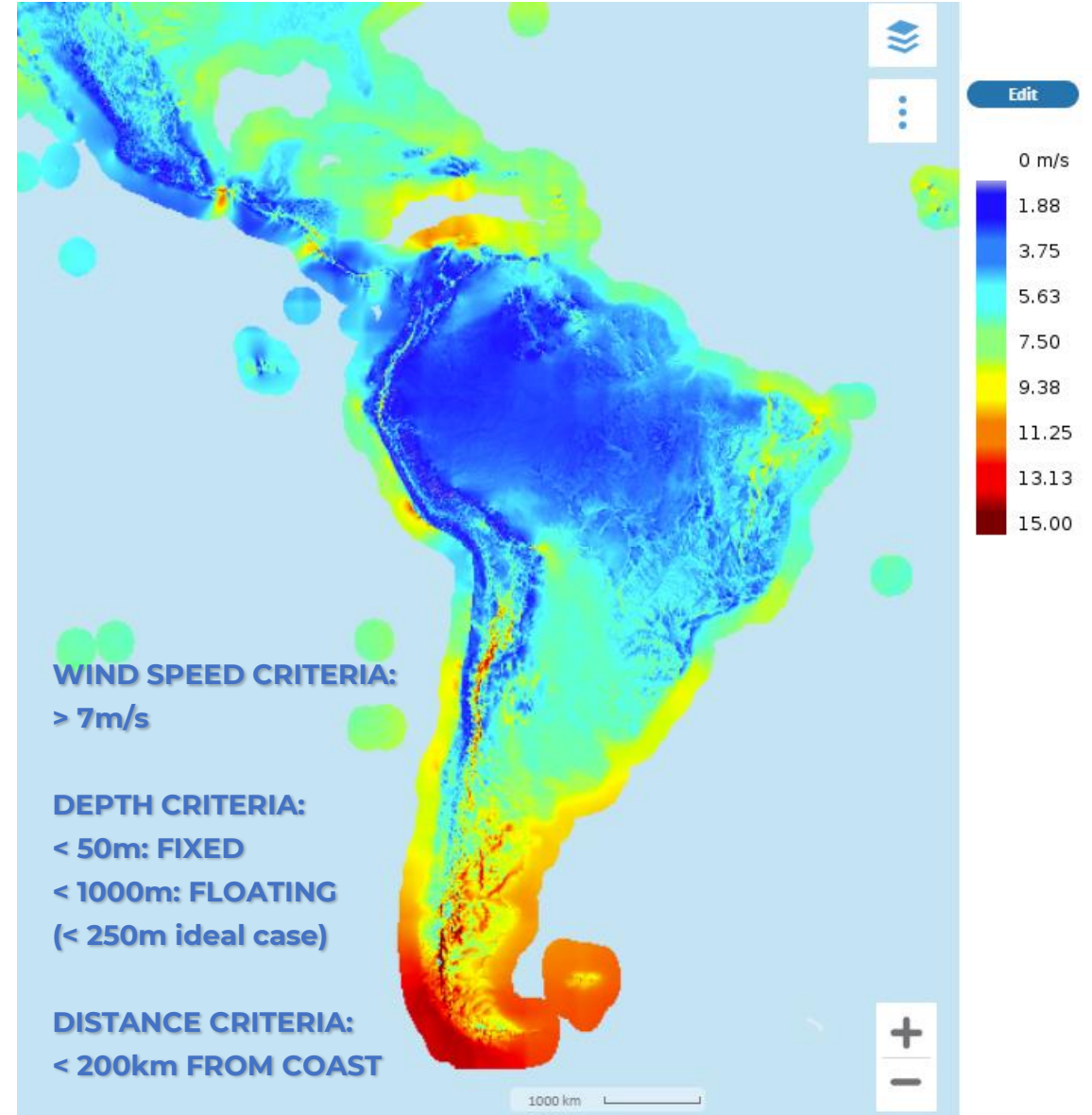
< 1000m: FLOATING

(< 250m ideal case)

DISTANCE CRITERIA:

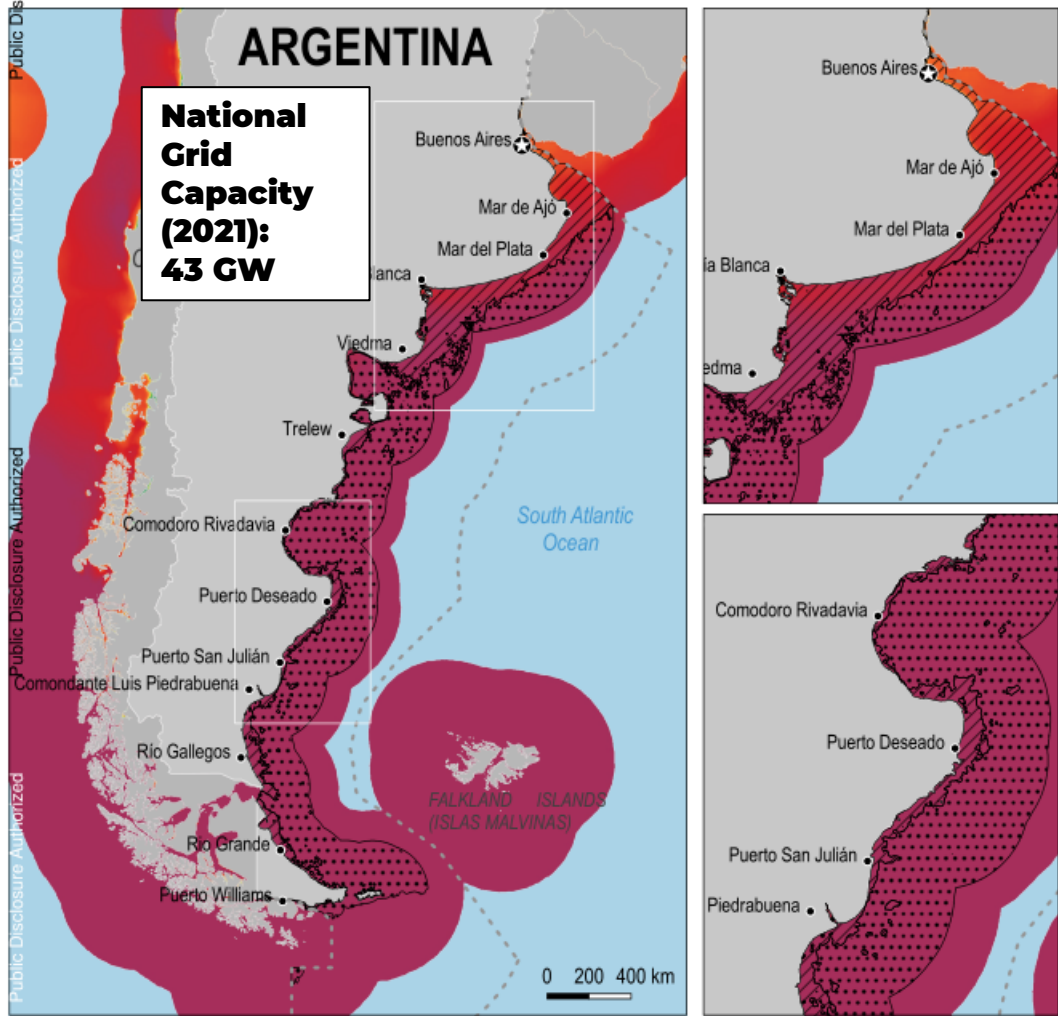
< 200km FROM COAST

SITES AND RESOURCE



POTENTIAL SITES IN LATIN AMERICA (EXAMPLES)

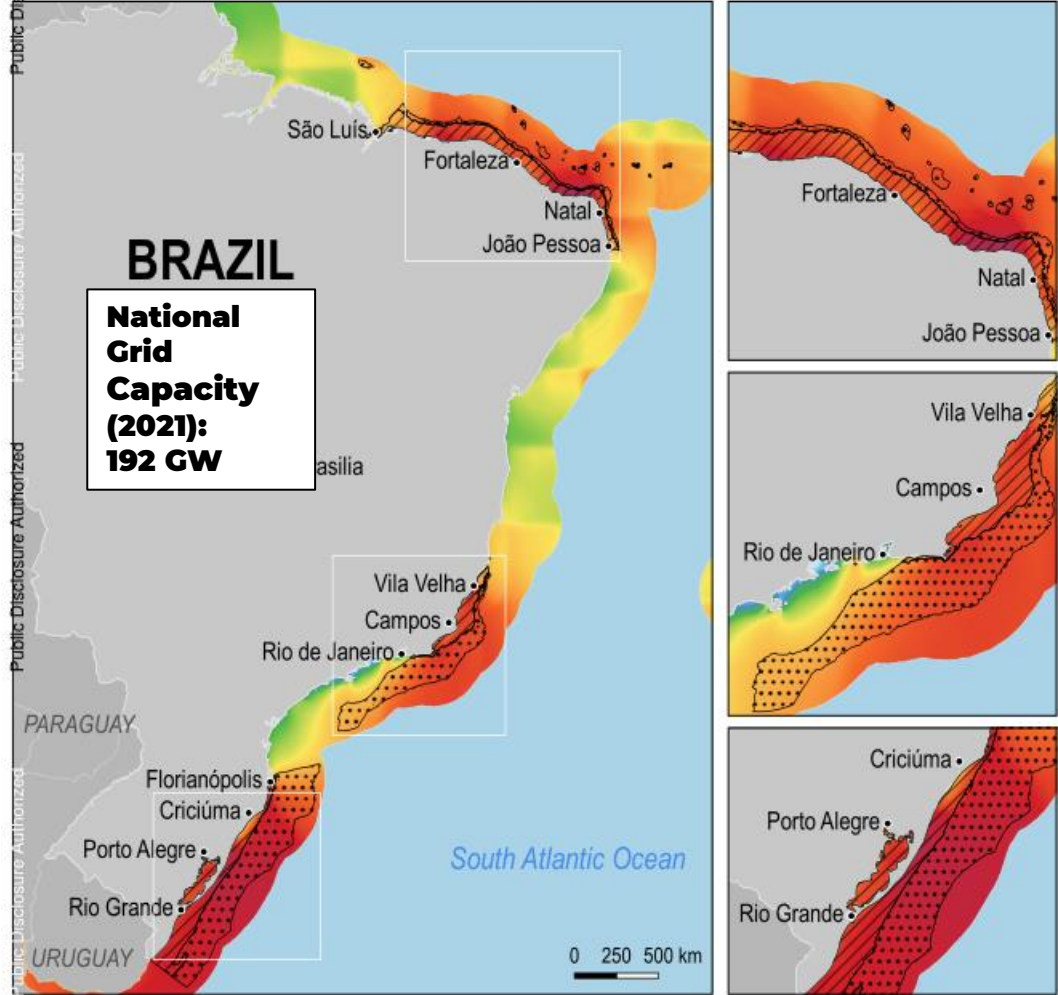
Offshore Wind Technical Potential in Argentina
RISE score: 59 Fixed: 558 GW || Floating: 1,312 GW || **Total: 1,870 GW**



Fixed (water depth < 50m)
Floating (water depth < 1000m)
--- Exclusive Economic Zone (EEZ)

WS (m/s) 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 7.5 8 8.5 9 9.5 >10

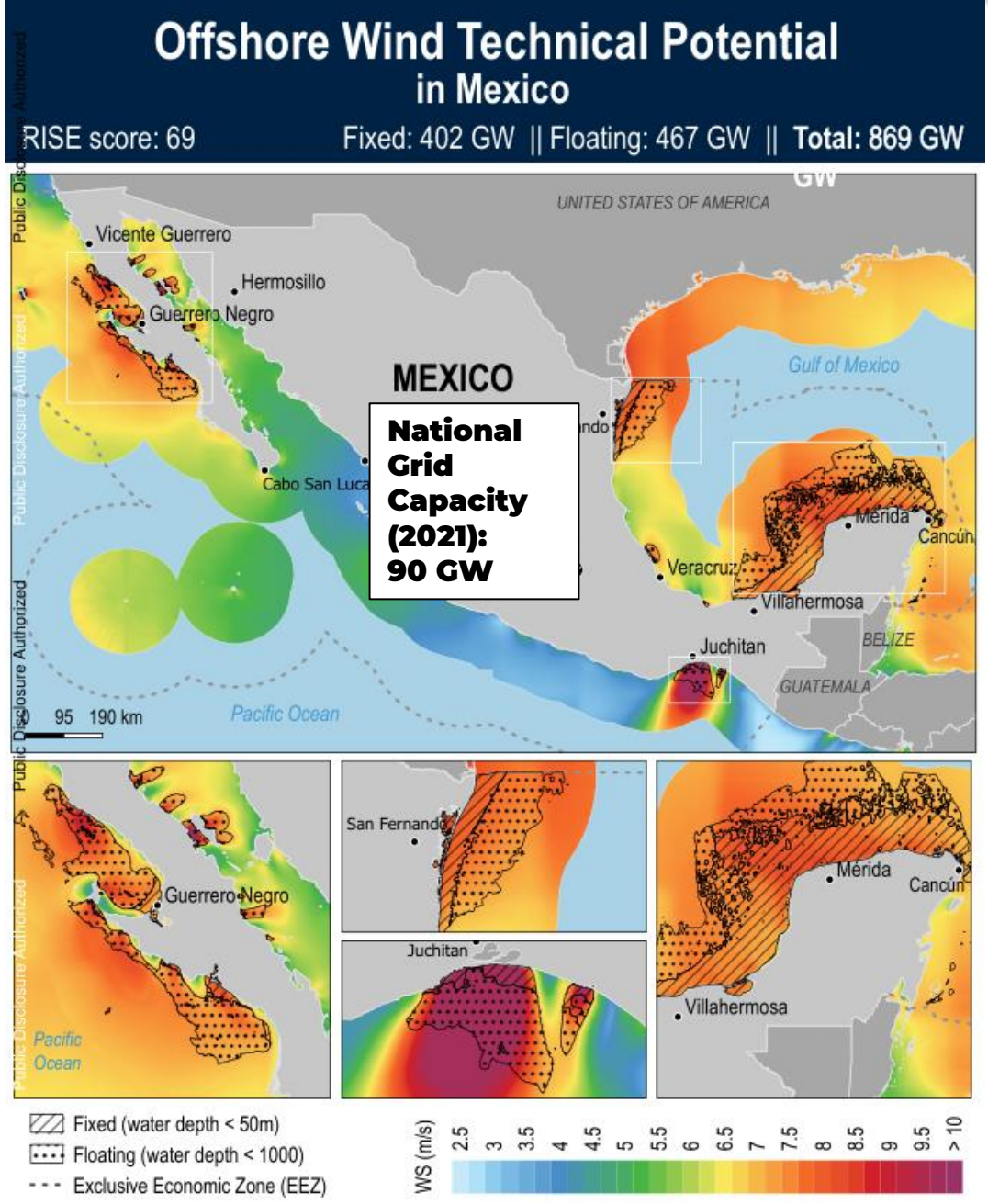
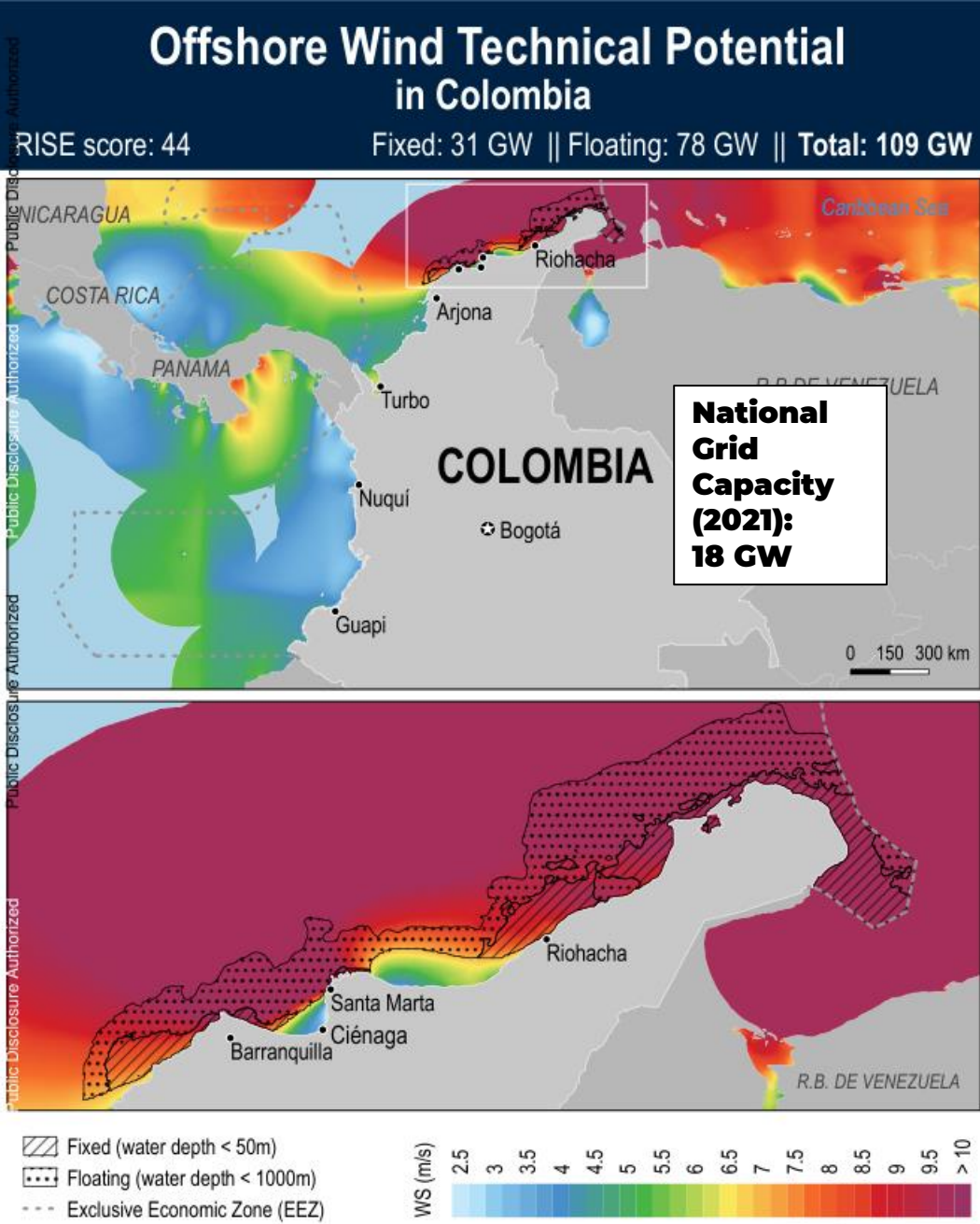
Offshore Wind Technical Potential in Brazil
RISE score: 71 Fixed: 480 GW || Floating: 748 GW || **Total: 1,228 GW**



Fixed (water depth < 50m)
Floating (water depth < 1000m)
--- Exclusive Economic Zone (EEZ)

WS (m/s) 2.5 3 3.5 4 4.5 5 5.5 6 6.5 7 7.5 8 8.5 9 9.5 >10

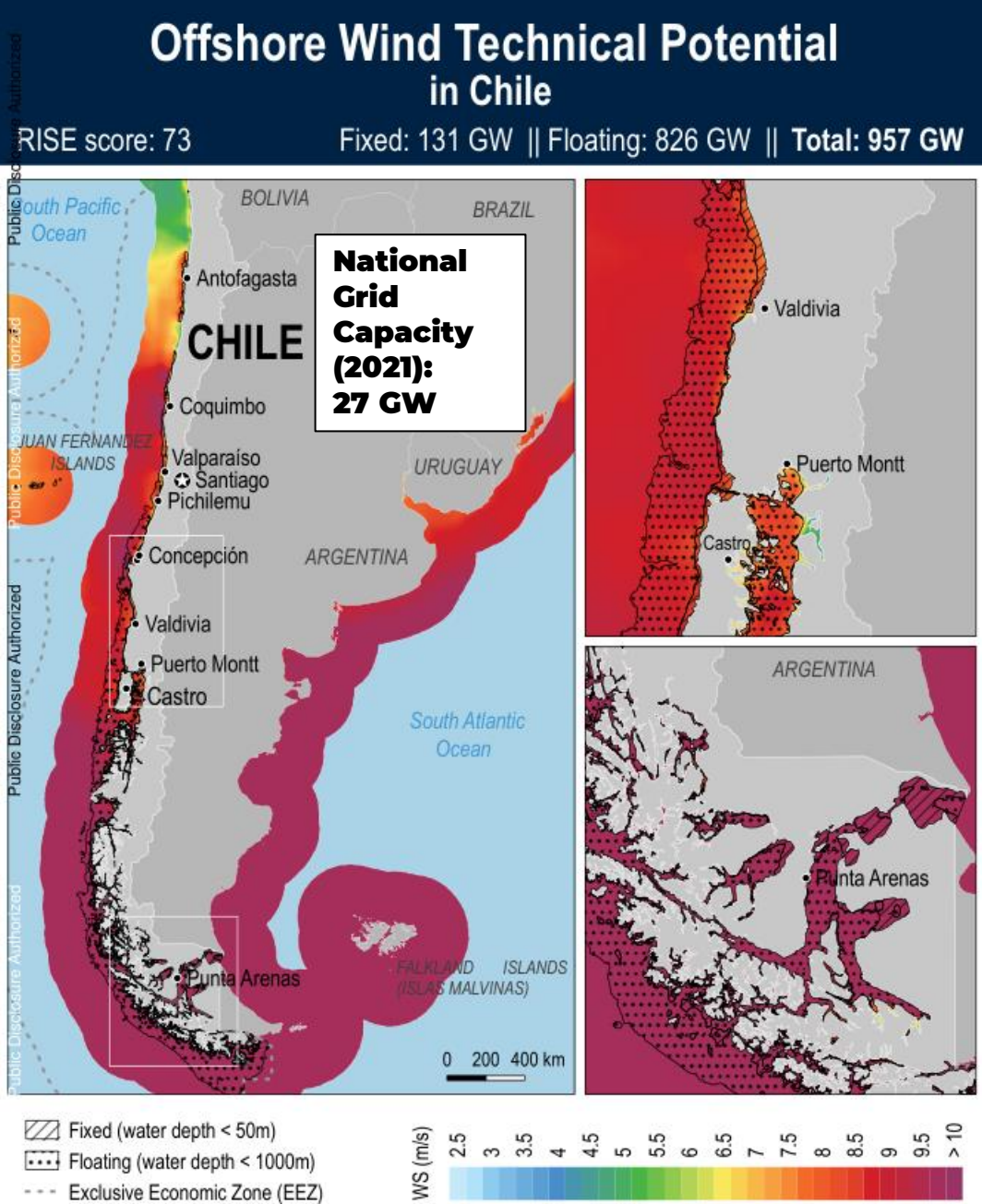
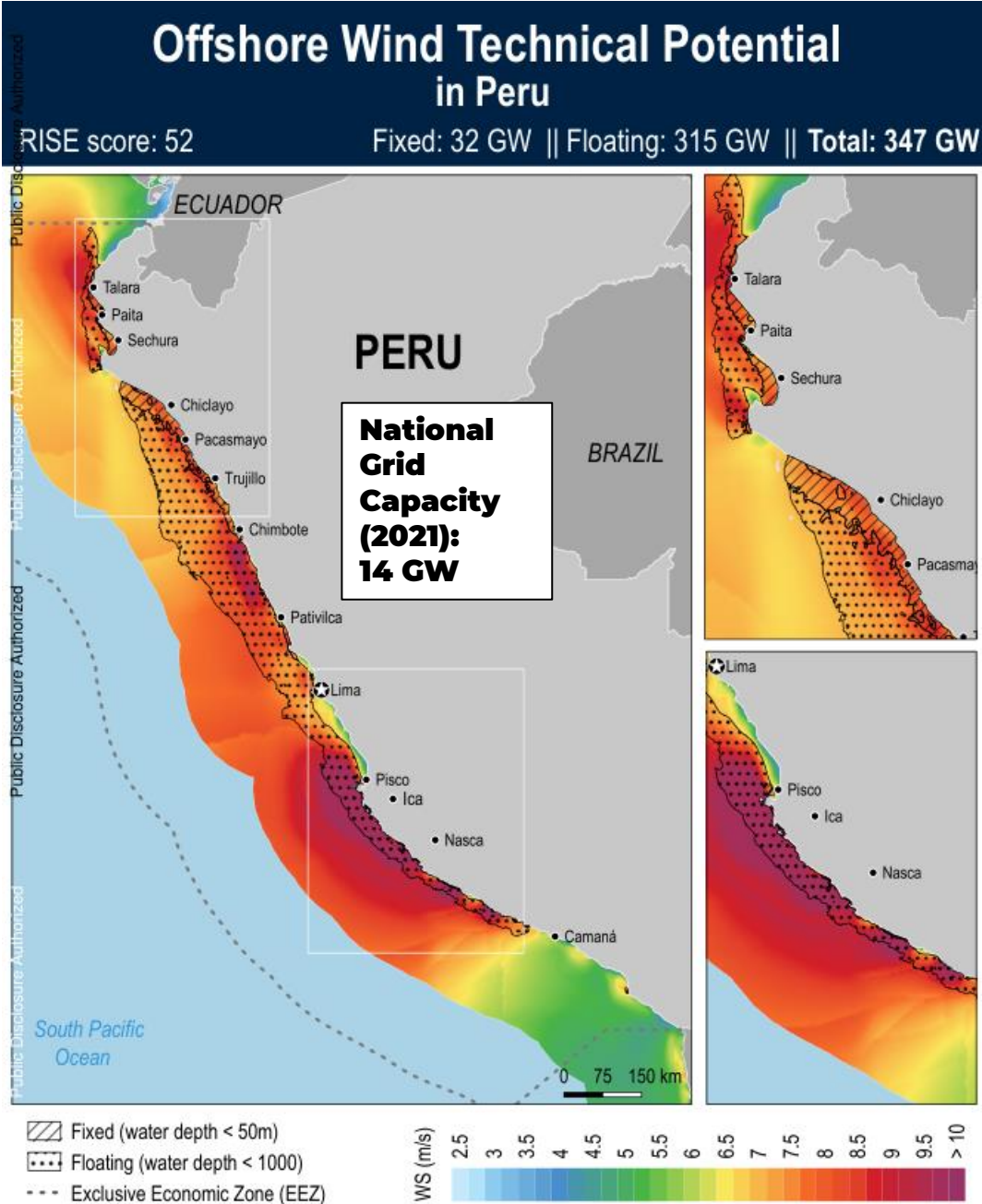
POTENTIAL SITES IN LATIN AMERICA (EXAMPLES)



Published: March 2020 (revised May 2020)
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POTENTIAL SITES IN LATIN AMERICA (EXAMPLES)

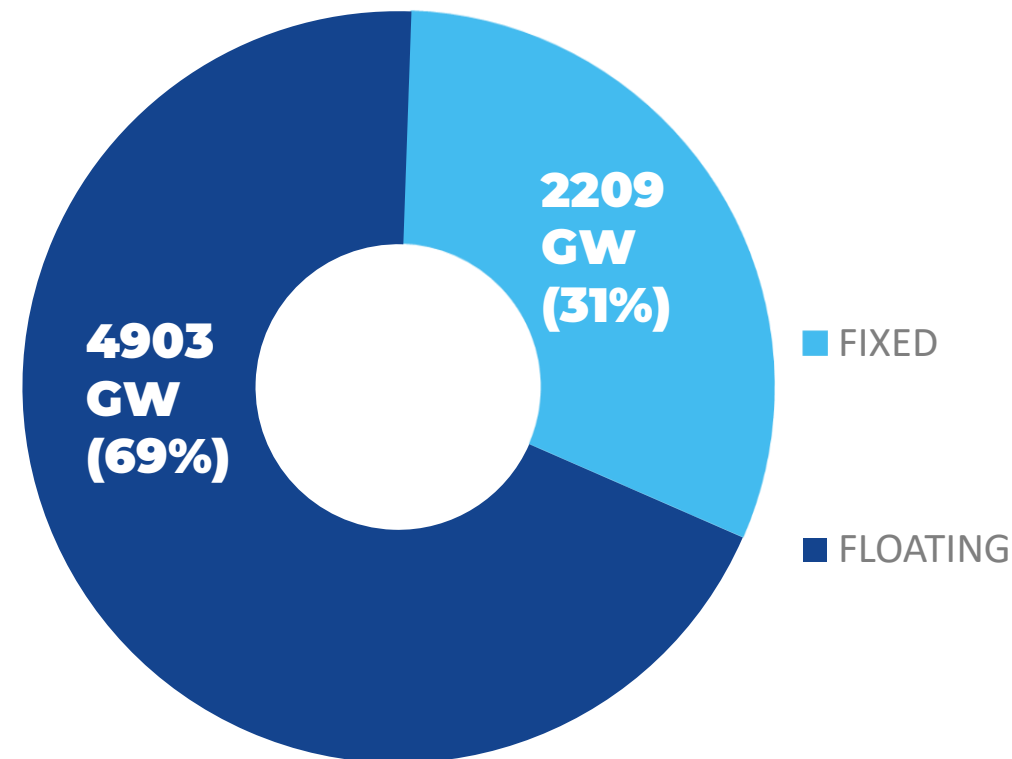


Offshore Wind Technical Potential in Latin America

Top 10 Countries in LAC Region

Country	RISE Score	Total (GW)	Fixed (%)	Floating (%)
Argentina	59	1870	30%	70%
Brazil	71	1228	39%	61%
Chile	73	957	14%	86%
Mexico	69	869	46%	54%
Venezuela	19	381	30%	70%
Perú	52	347	9%	91%
Uruguay	56	275	69%	31%
Colombia	44	109	28%	72%
Honduras	39	91	64%	36%
R. Dominicana	59	63	19%	81%

RISE: Regulatory Indicators for Sustainable Energy



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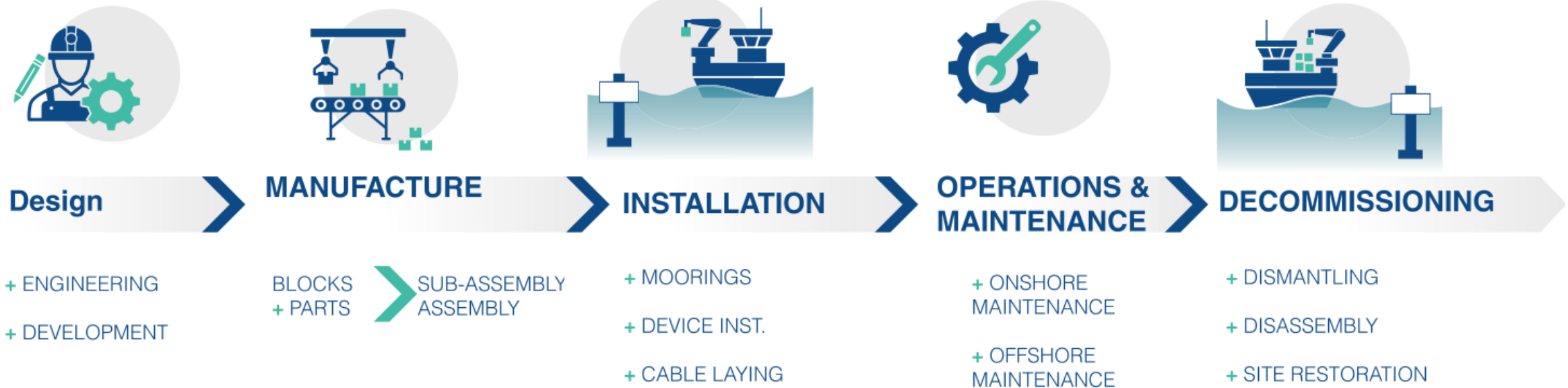
ESMAP

Energy Sector Management Assistance Program

Challenges



ORE Project Development

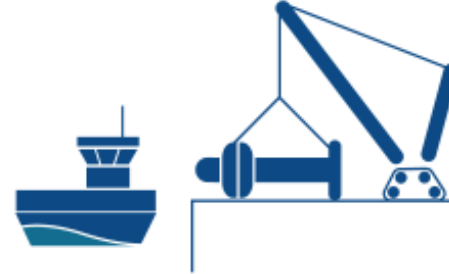


The manufacture, installation, maintenance, and decommissioning must be carried out with the locally available infrastructure and equipment or, alternatively, consider scale economies that allow incorporating this equipment or this infrastructure in the long term.

Critical Aspects for Manufacture, Installation and Maintenance



SUPPORT
VESSELS



PORTS AND
INFRASTRUCTURE



LIFTING



OPERATIONAL
ASPECTS

OFFSHORE WIND PLATFORMS

MONOPILE

JACKET

TRIPOD

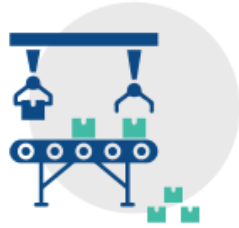
SEMISUB

TLP

SPAR

NOMINAL POWER > 18MW
ROTOR DIAMETERS > 200m
MASS > 10.000 t
FOOTPRINT > 75m X 75m

Challenges



MANUFACTURE



Steel
vs
Concrete
Launching
Footprint
Time



Source: windssystemsmag.com

Author: Untrakdrover. License: CC BY-SA 3.0



Source: Equinor



Source: Navantia



Source: Floatgen.eu

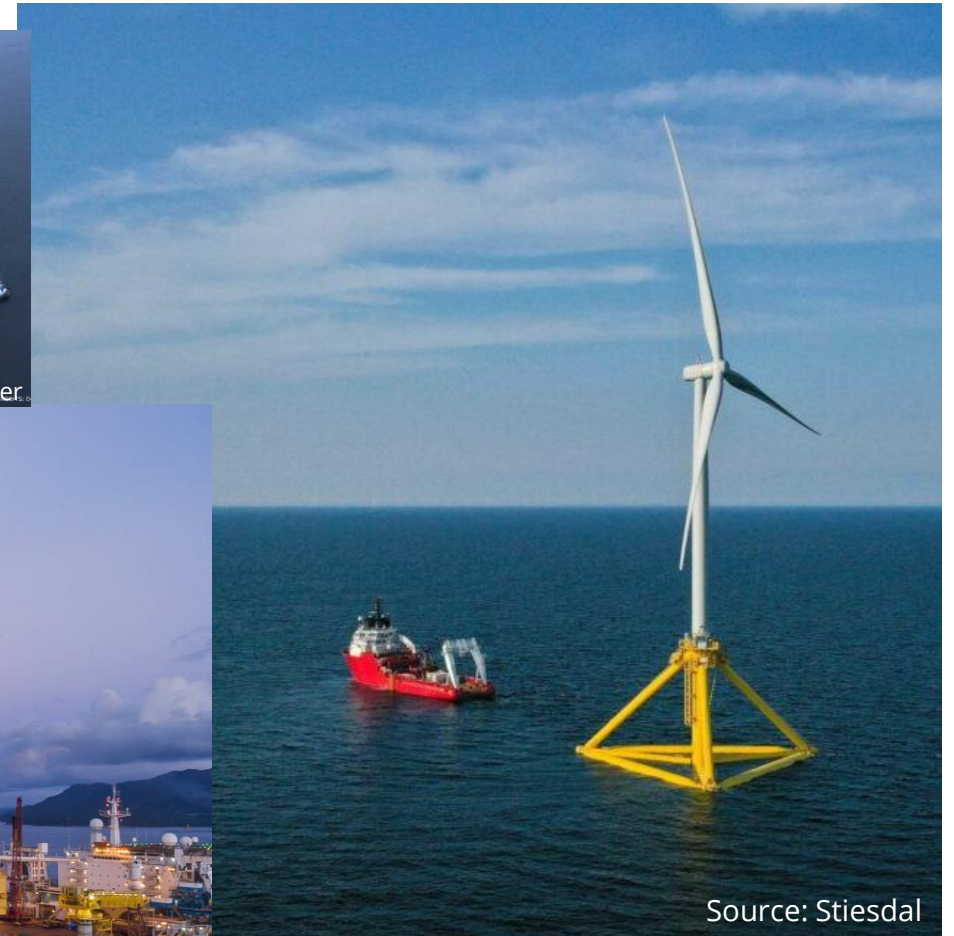


Source: Floatgen.eu

Challenges



Lifting
Weather
windows
DP Ships
Operations
Time



Challenges



➤ OPERATIONS &
MAINTENANCE

Dry vs Wet

Weather
windows

Ships
Operations
Accessibility



Challenges: Accessibility (Example)



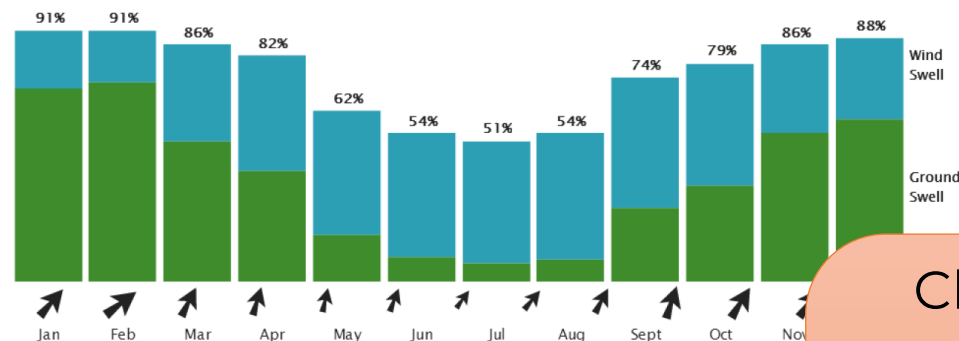
Consistency:

% of time with $H_s > 1\text{m}$ and

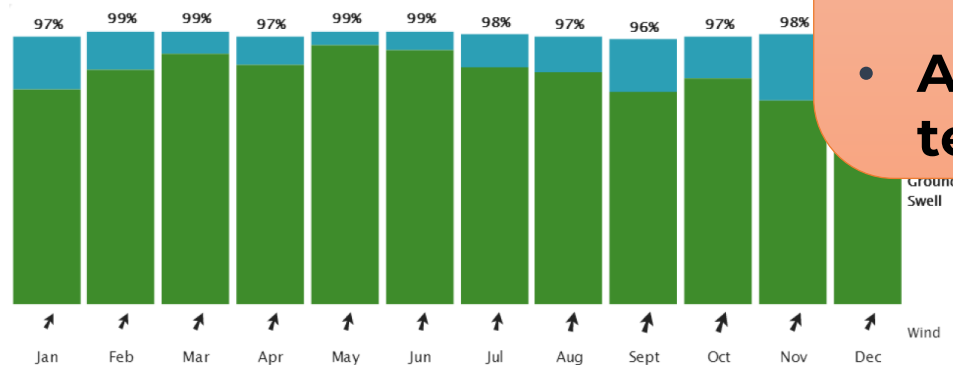
$T_m > 7\text{s}$ for wind swell or

$T_m > 10\text{s}$ for ground swell

Orkney, UK:



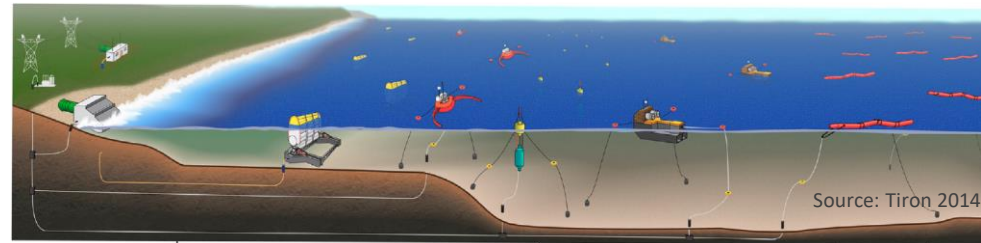
Antofagasta, Chile:



Challenges:

- Adapt installation techniques
- Adapt O&M techniques

Challenges: Extreme Sea States



On-shore	Near-shore	Off-shore
Storms, tsunamis, breaking waves		Extreme waves

- Challenges:
- Event characterization and modelling
 - Loads Prediction and mooring optimization
 - Survival mode



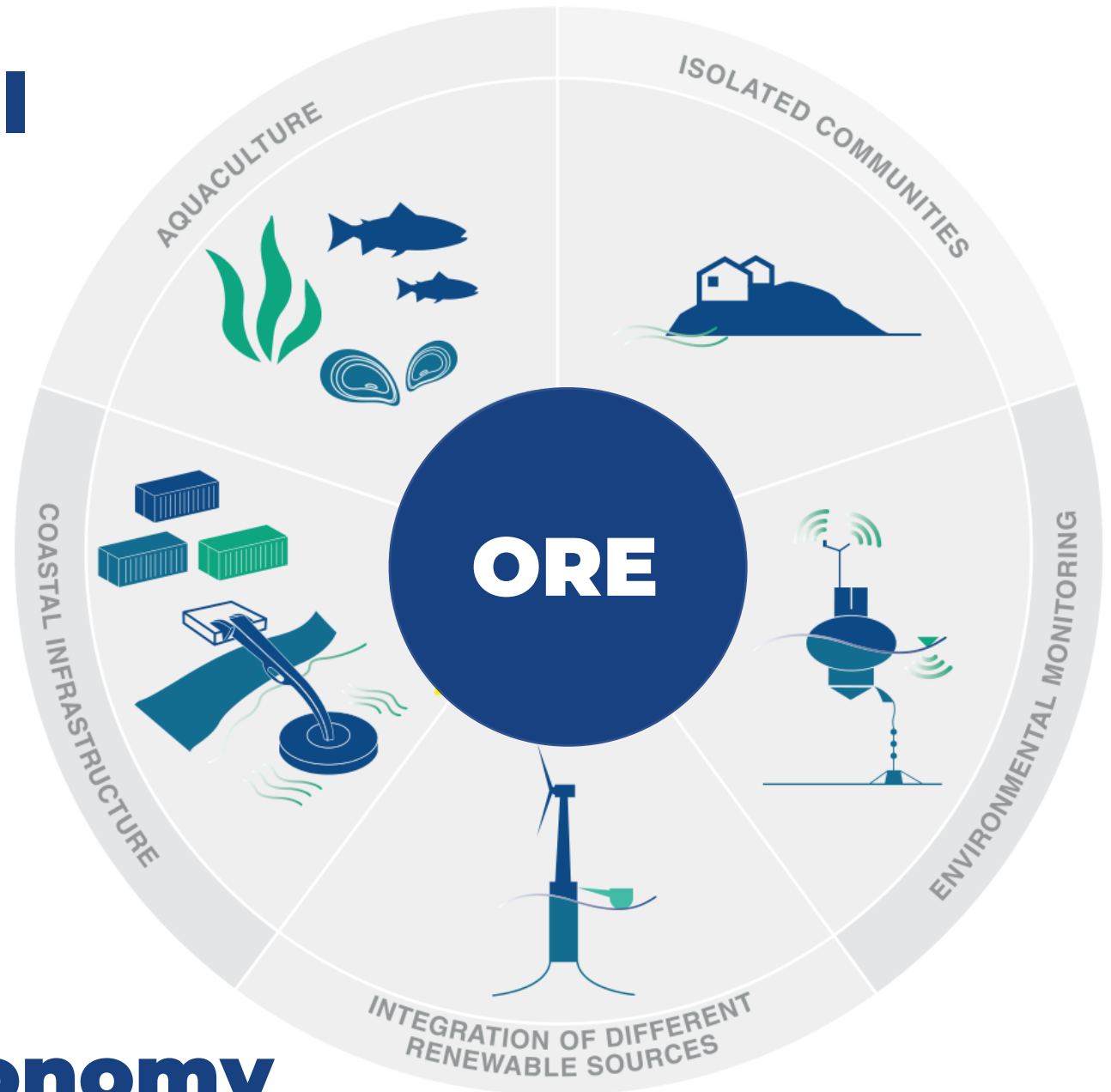
Opportunities



Opportunities: Local niche applications

Latin America offers unique niche applications for ORE, covering the needs of local communities, industries and governments

Blue Economy



Example

Opportunities: Local niche applications

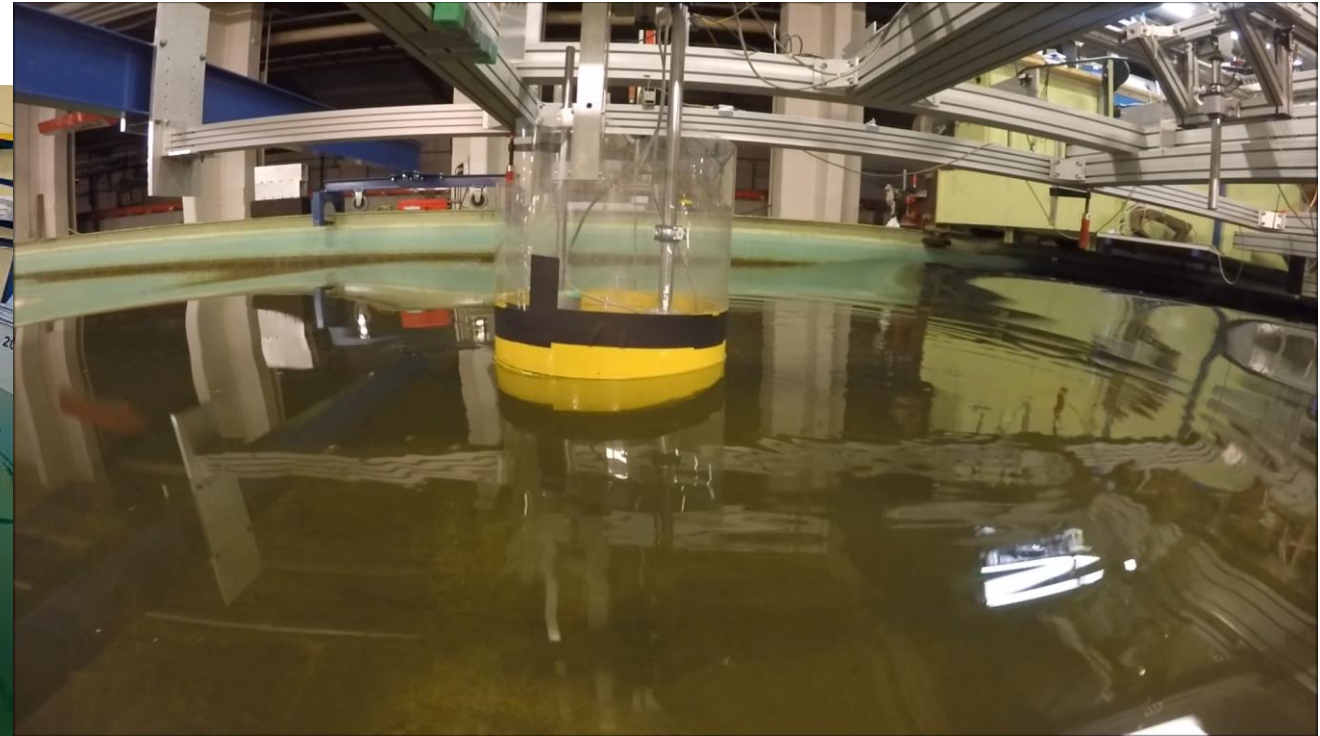
**Development of
small-scale FWT for
aquaculture and
isolated
communities**



Example

Adaptation of Technologies for Extreme Conditions

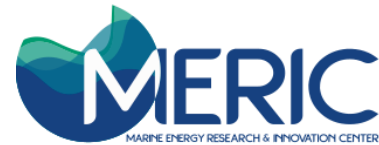
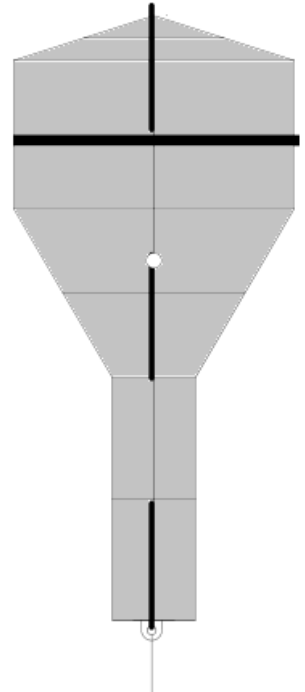
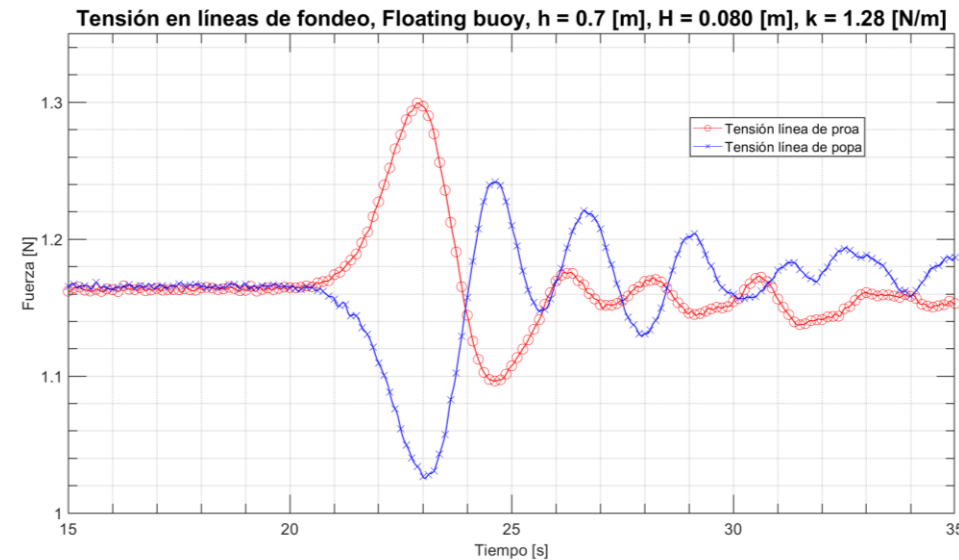
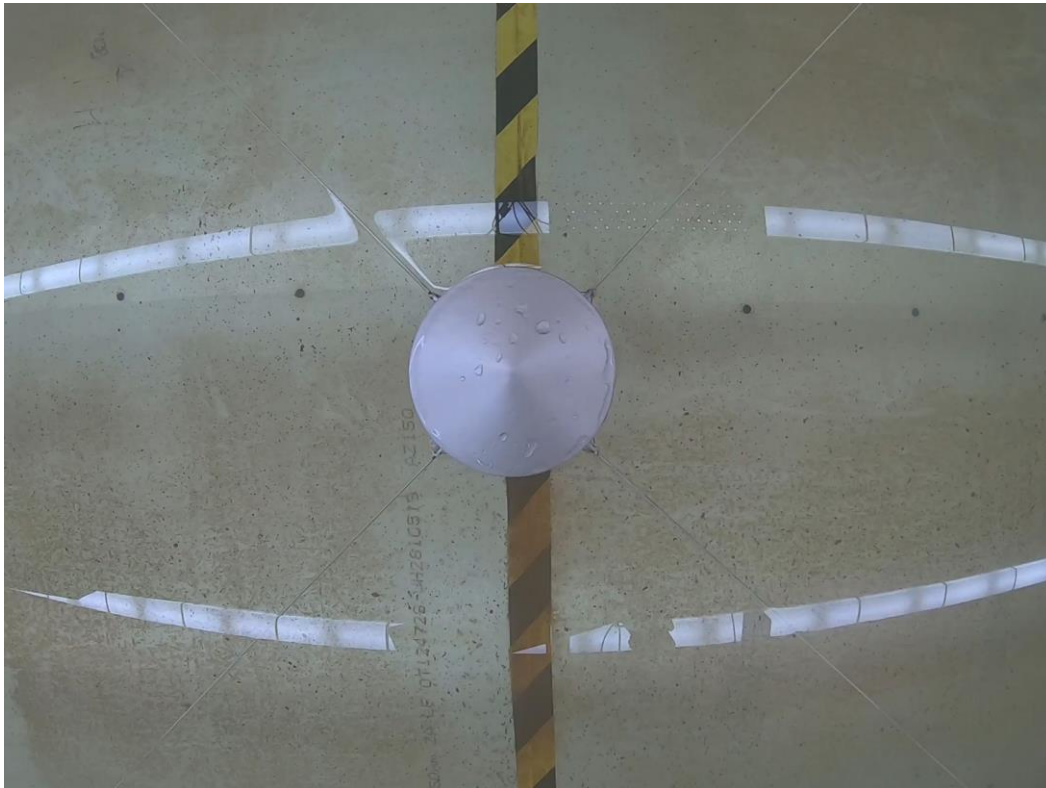
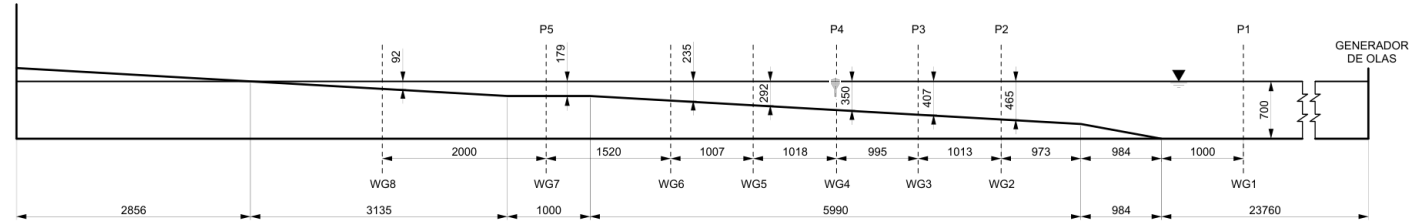
Local knowledge is key for the analysis of the extreme conditions of each site



Example

Adaptation of Technologies for Extreme Conditions

Preliminary tests of tsunami-like waves on generic WECs for further analysis with numerical tools

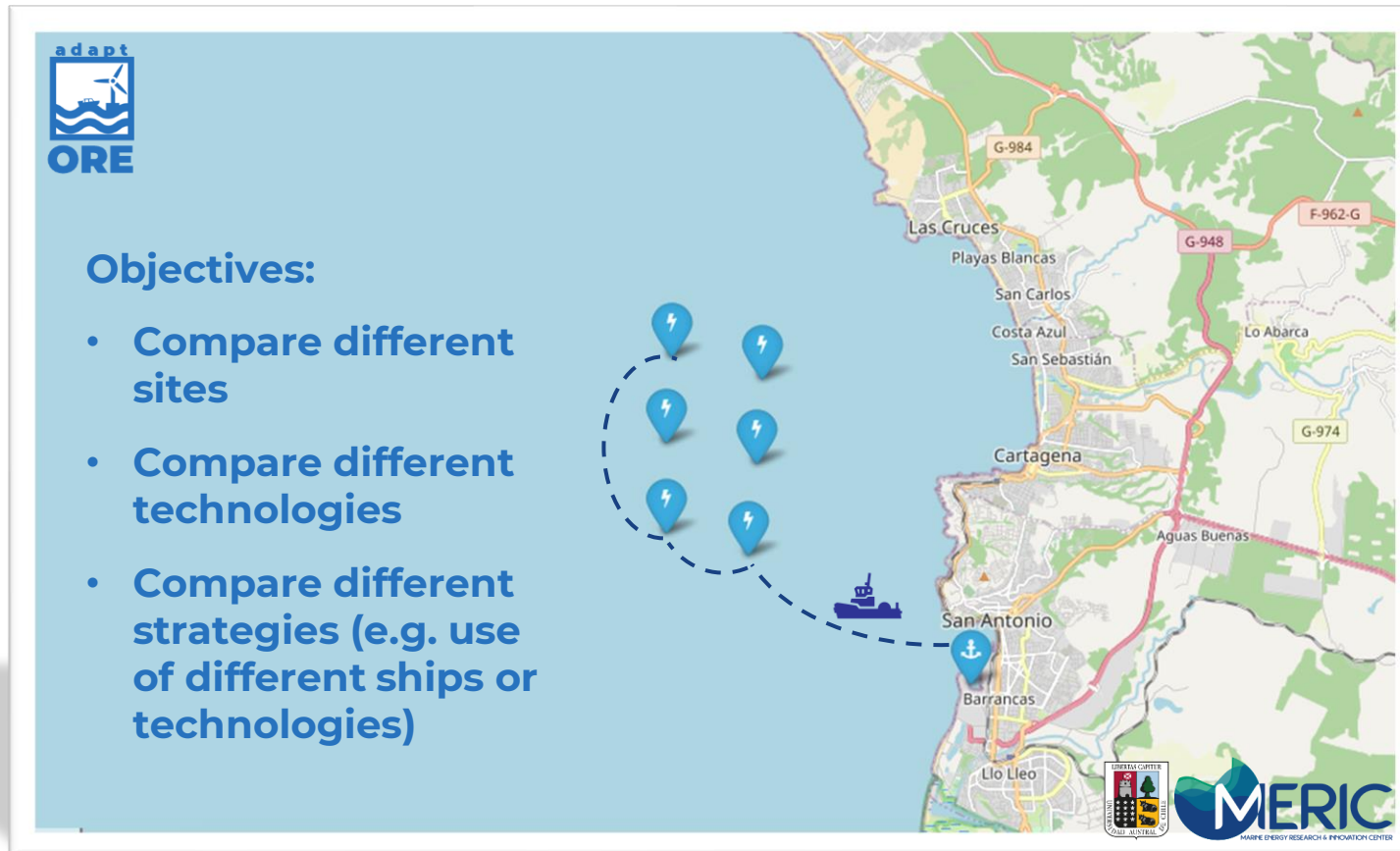


Example

Adaptation of Technologies and Operations



Example: Development of simulation Tool “adaptORE” for ORE operation and maintenance analysis



Features:

- Georeferenced
- Time-domain
- Behind-casts

Entities:

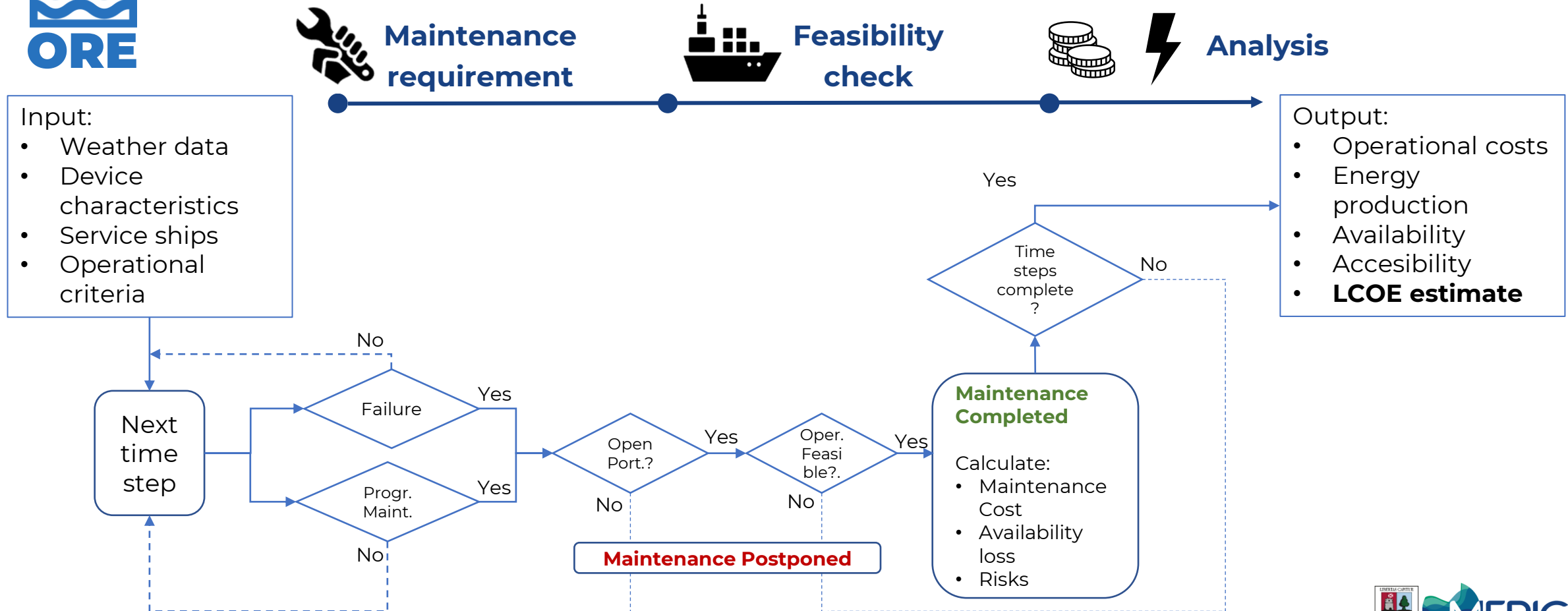
- ORE Devices
- Support ships
- Ports
- Maintenance strategies (under development)

Example

Adaptation of Technologies and Operations



Time-domain simulation

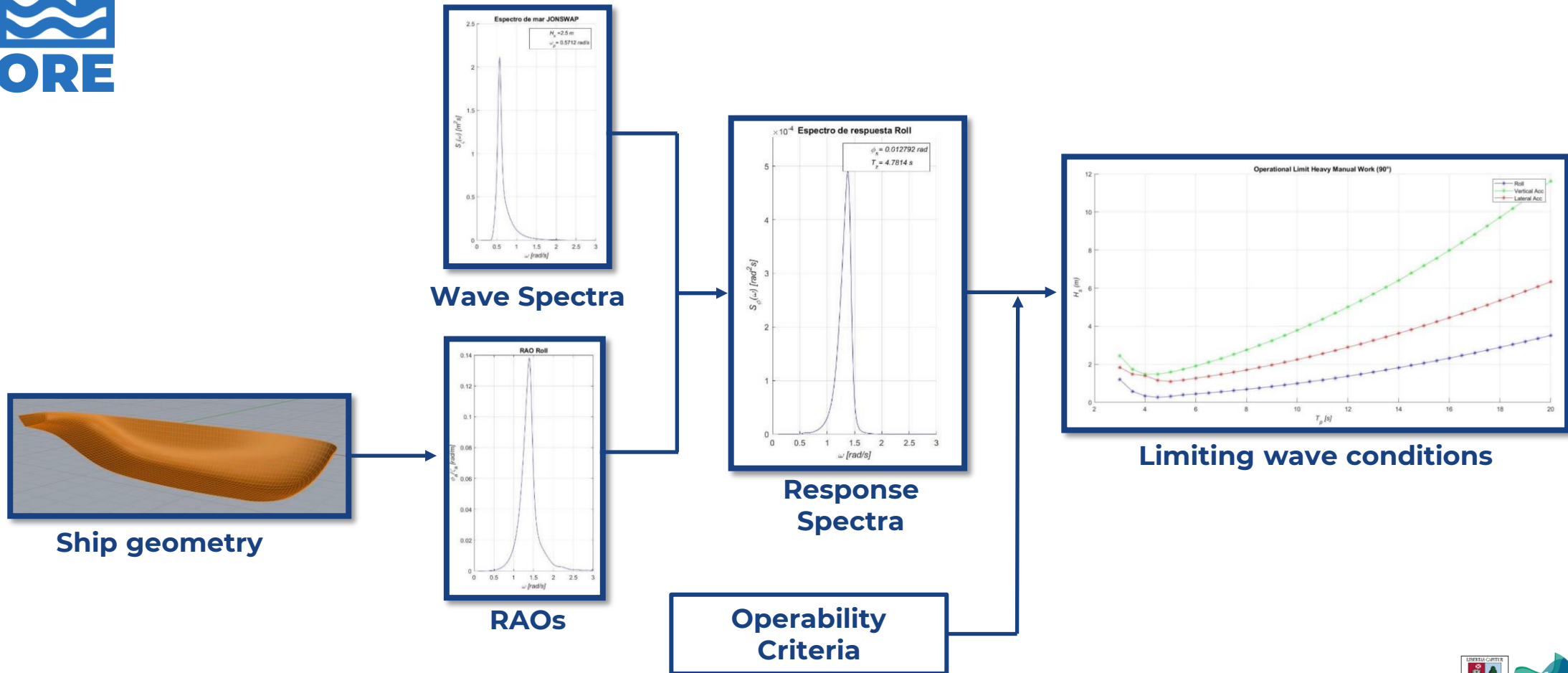


Example

Adaptation of Technologies and Operations



Operational Limiting Curves

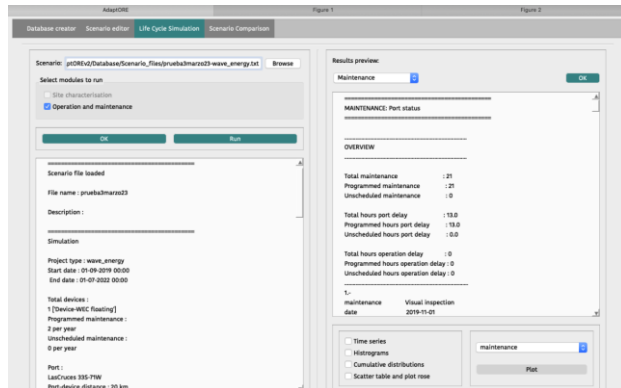


Example

Adaptation of Technologies and Operations



Results
(Example)

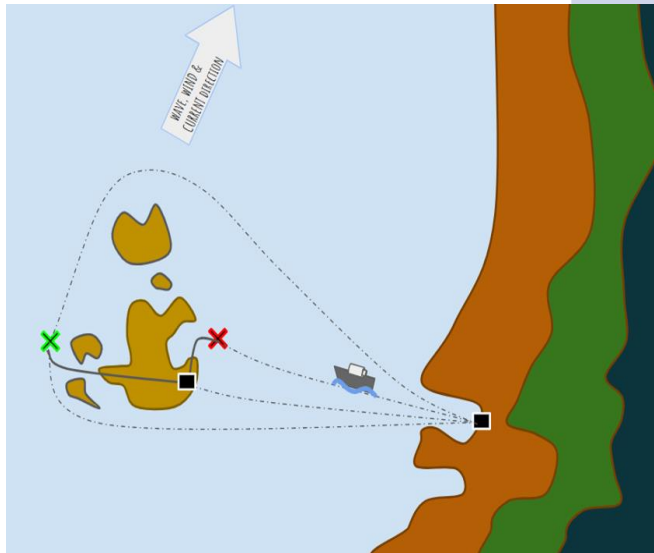


Example

Adaptation of Technologies and Operations



Results (Concept)



Site	Scenario	Accessi- bility	Availa- bility	Capacity Factor	LCOE
A	1	70%	94%	46%	72
	2	55%	89%	38%	88
B	1	53%	87%	34%	82
	2	43%	82%	32%	93
C	1	64%	92%	41%	78
	2	53%	86%	36%	86

Special Ships and Support Systems

- Local design and construction of specialized ships and naval structures, adapted to local requirements (market diversification)
- Innovation and technology transfer at different scales (valuable local experience combined with international experience)

Special Ships and Floating Structures



Multicats

Source: Damen



Jack-up barges

Source: Liebherr



CTVs

Source: Wind Power Engineering

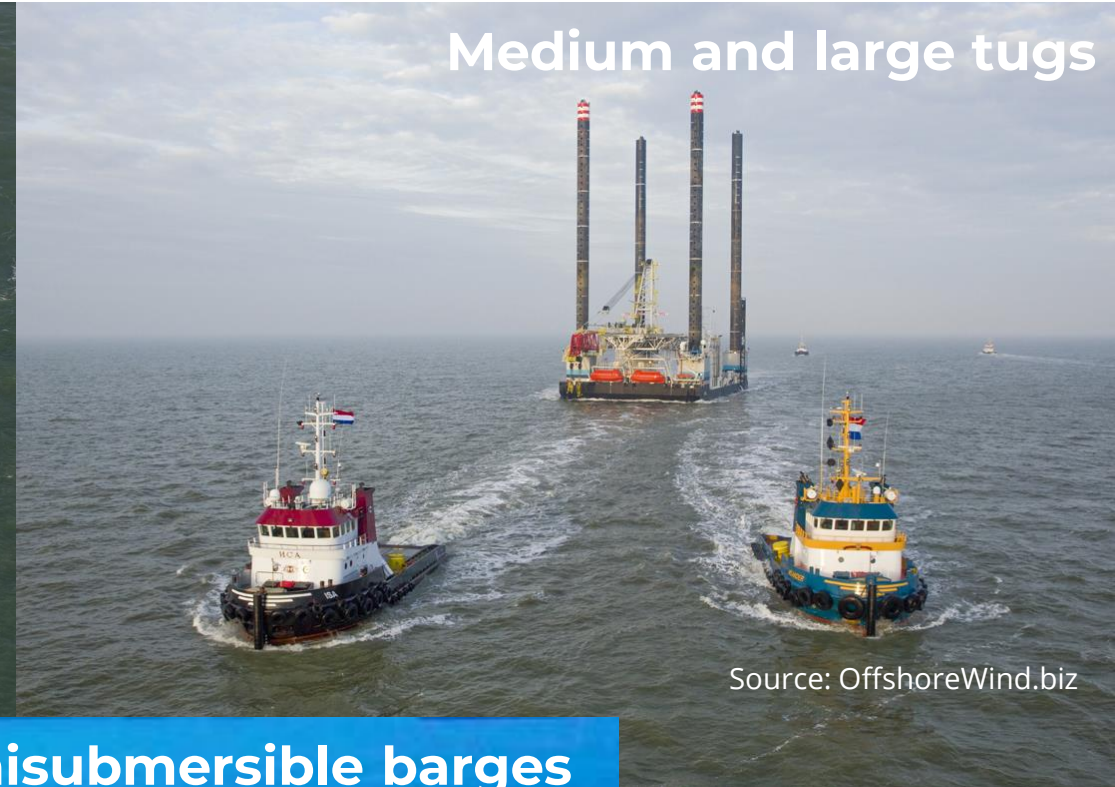
Special Ships and Floating Structures

ORE Service Vessel with W2WG



Source: Bibby Marine

Medium and large tugs



Source: OffshoreWind.biz

Multi-purpose semisubmersible barges



Source: Damen

Construction Sites

Floating Construction Facilities

Assembly Sites

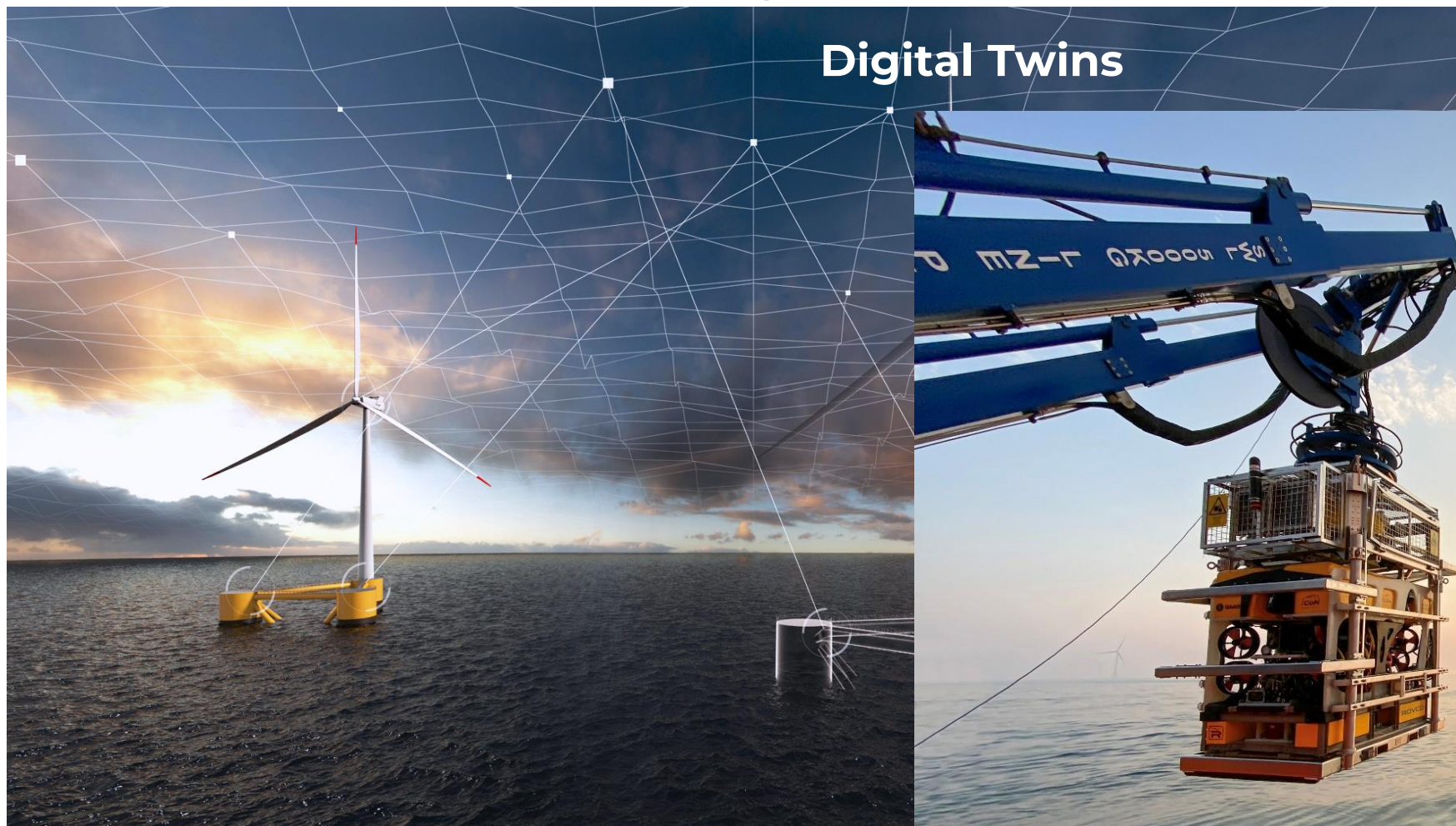
Port and shipyard development

Source: Greentech media

Source: Renewablesnow



Other Support Systems



Conclusions

Offshore Renewable Energy is a unique opportunity for Latin America

- Latin America has excellent conditions for the development of ORE, with varying conditions along its coastline.
- These varying conditions require different technologies and approaches, with a strong emphasis on **local knowledge** and **local content**, which can have an important impact on local economies and communities
- Regional collaboration can play a key role, along with collaboration with technology providers
- Unique challenges ahead!

Thank you!

Gonzalo Tampier

gonzalo.tampier@uach.cl

