PAMEC Energy Association

Marine Renewable Energy - Colombia

PhD. Andrés F. Osorio

Director CEMarin

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Corporation Center of Excellence in Marine Sciences

Osorio AF. , Roldan-Carvajal M. , Colmenares F. , Álvarez O. , Montoya R.D. , Rueda-Bayona J.G. , Rodriguez E., Maturana A. , Sánchez C. , Herrera J. , Toro V., Arango-Aramburo S.

Universidad Nacional de Colombia
UTADEO
Universidad del Valle
Universidad de los Andes
Universidad de Antioquia
Justus-Liebig-Universität Gießen

About me…

Andrés Fernando Osorio Arias

- Civil Engineering
- PhD. Marine Science and Technology

- Executive Director CEMarin
- Prof. Universidad Nacional de Colombia, Sede Medellín
- Designated 2022 - Advisor National Scientific Council – Ocean Focus

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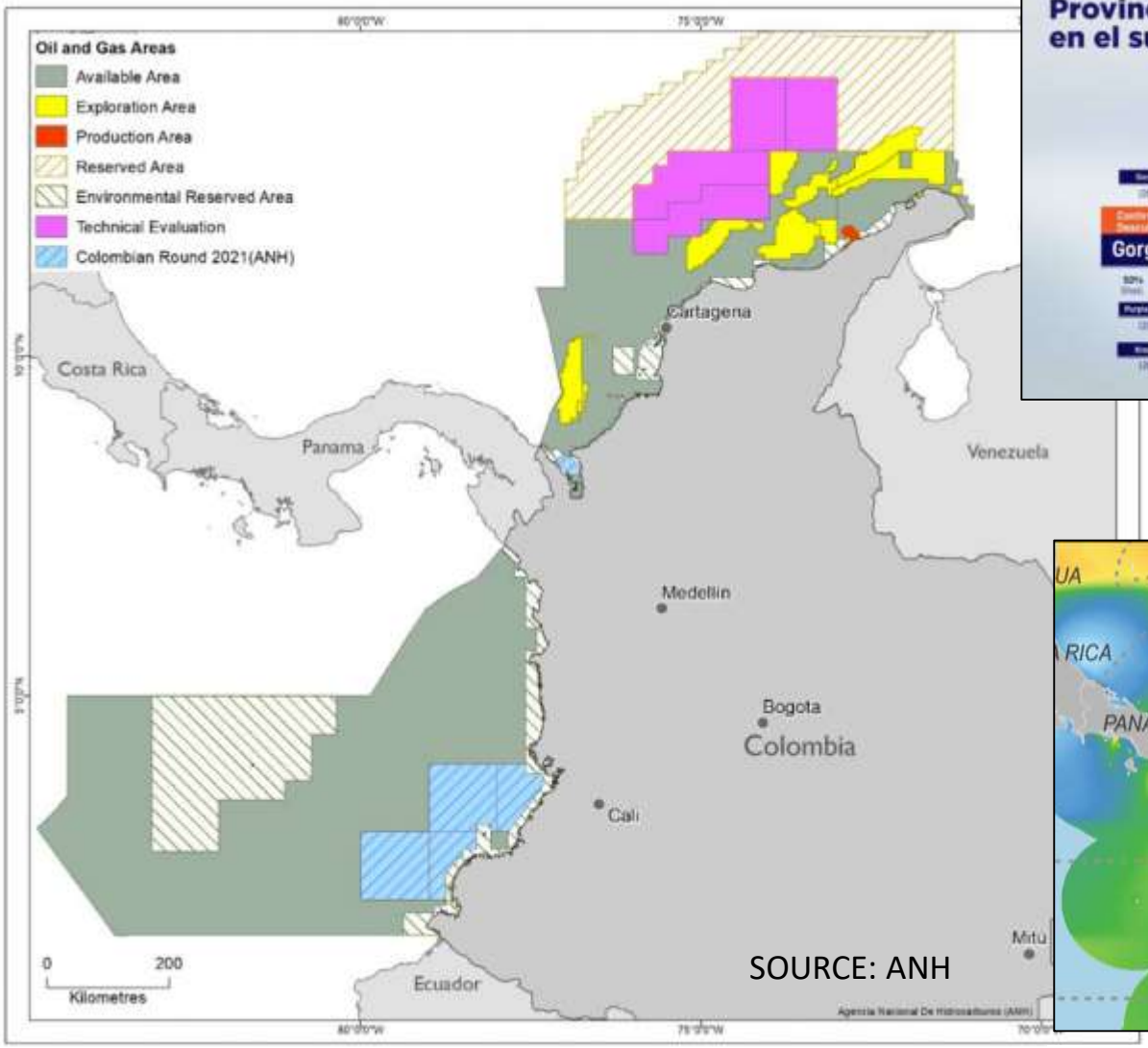
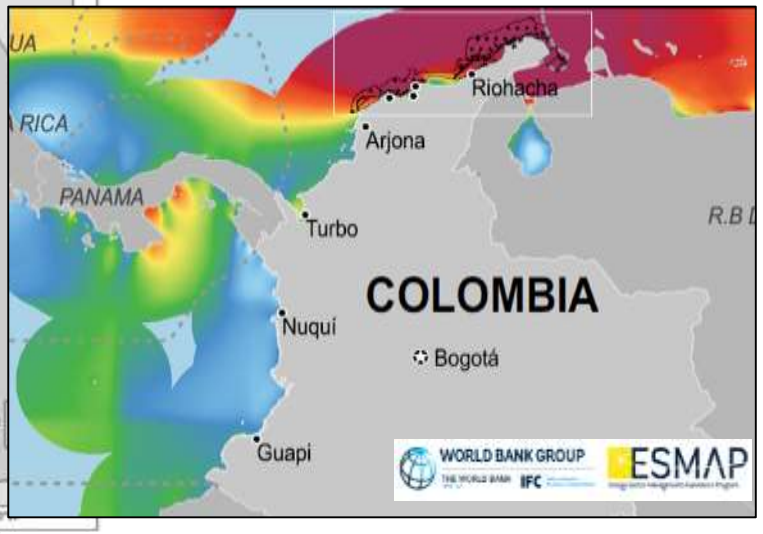
OFFSHORE EXPLORATION (OIL, GAS, WIND OFFSHORE)



WIND OFFSHORE



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

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LEY 1715 DE 2014

(mayo 13)

Diario Oficial No. 49.150 de 13 de mayo de 2014

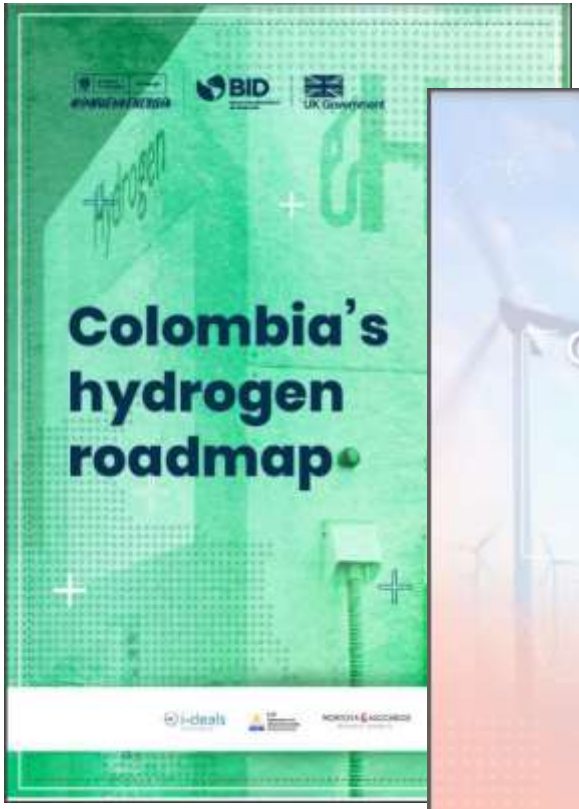
CONGRESO DE LA REPÚBLICA

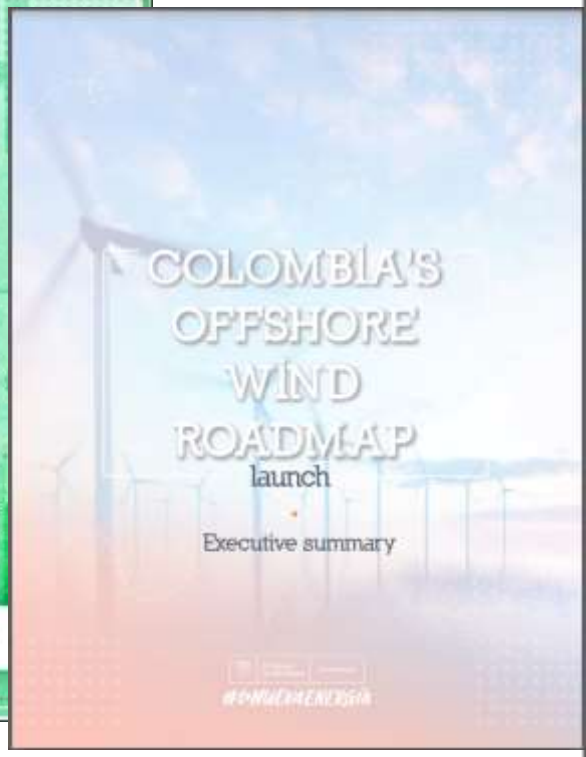
ARTÍCULO 23. DESARROLLO DE LA ENERGÍA DE LOS MARES. Será considerada la energía de los mares, entendida como el aprovechamiento de las olas, el aprovechamiento de las mareas y el aprovechamiento del diferencial térmico de los océanos

Documento
CONPES
3990

CONSEJO NACIONAL DE POLÍTICA ECONÓMICA Y SOCIAL
REPÚBLICA DE COLOMBIA
DEPARTAMENTO NACIONAL DE PLANEACIÓN

COLOMBIA POTENCIA BIOCEÁNICA SOSTENIBLE 2030





Documento
CONPES
4075

CONSEJO NACIONAL DE POLÍTICA ECONÓMICA Y SOCIAL
REPÚBLICA DE COLOMBIA
DEPARTAMENTO NACIONAL DE PLANEACIÓN

POLÍTICA DE TRANSICIÓN ENERGÉTICA

Bogotá, D.C., 29 de marzo de 2022

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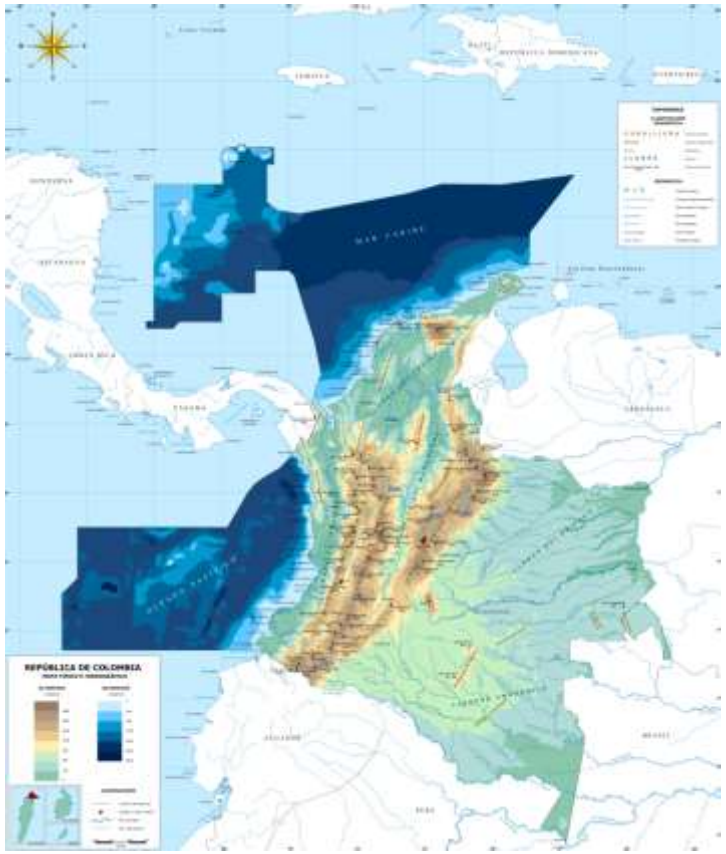
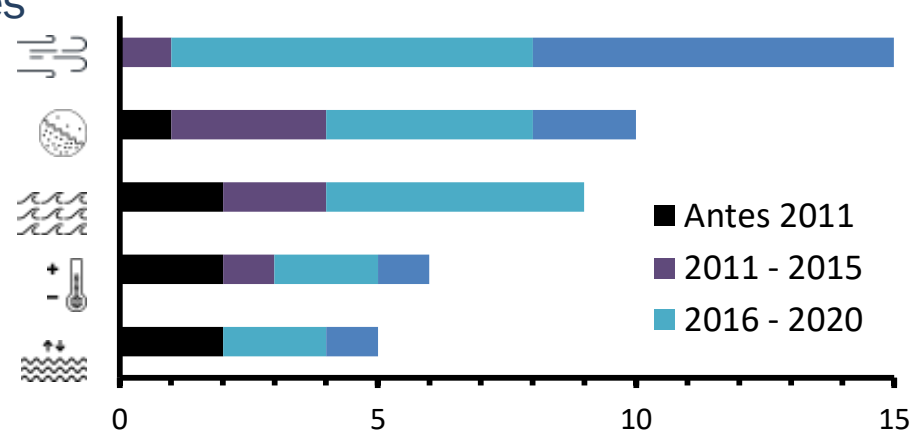
FACULTAD DE MINAS

Marine Energy Colombia - Papers

Current electrical grid covers: 40% of territory and 97% of population's demand.
But SEVERAL zones are Non-connected zones (ZNI)



We are not at zero: all marine energy sources have been explored from universities, at least their potential.



Artículos científicos

Resource assessment	14	General	3
Techniques	10	Technology	2
Road maps	4	Multidisciplinar	1

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ECOPETROL STRATEGY ON OCEAN ENERGY

ECOPETROL plans to evaluate the availability and feasibility of the use of renewable energies of marine origin in Colombia (offshore), which will allow the G.E to leverage the 2024 strategy in the energy transition and contribute to the achievement of the goals of developing clean, sustainable and scalable energy.

ECOPETROL STRATEGY

=

Alignment with **technological** challenges and **Sustainability**

Energy that Transforms

NET-ZERO CARBON EMISSIONS BY 2050

RENEWABLES ENABLE EMISSIONS REDUCTIONS +SELF-GENERATION ENERGY

+

Offshore Wind
Ocean currents
Tidal stream
Salinity and temperature gradients
Waves
Floating solar

Study, analyze, and prioritize ocean energy sources and technologies

introduction in the short medium and long term

H_2 (green)

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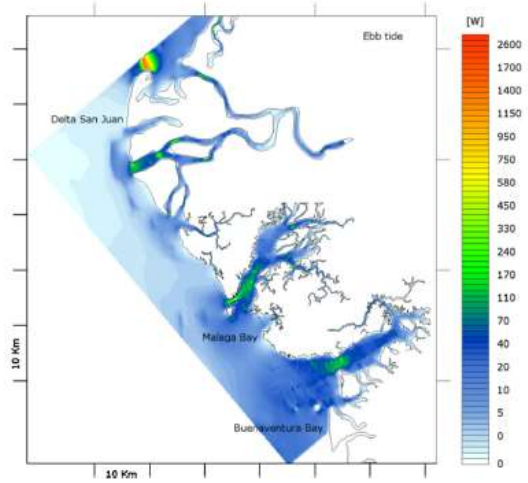
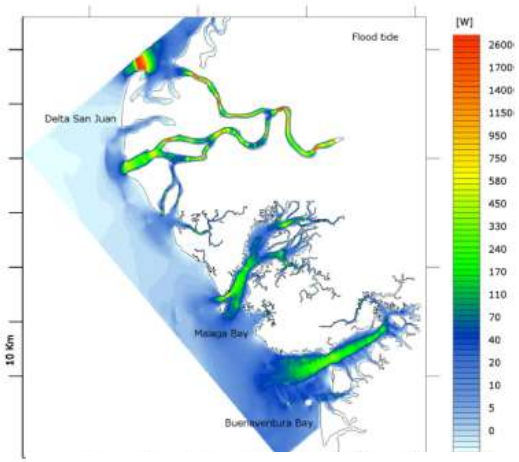
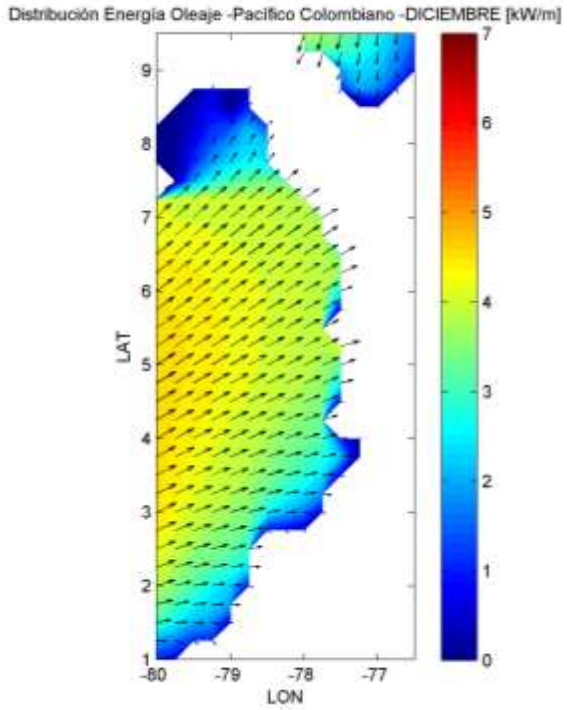
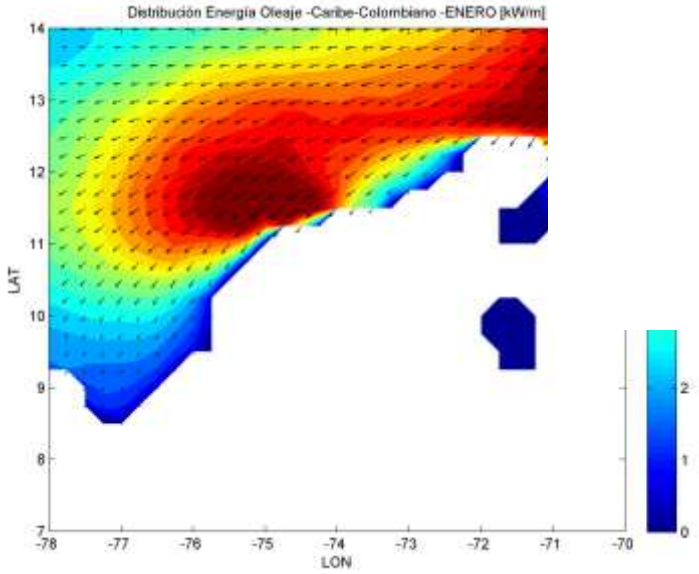
Energy potential from tides and waves

A.F. Osorio et al. Renewable and Sustainable Energy Reviews 53 (2016) 966–977









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Temperature gradients (OTEC) & Salinity Gradientes

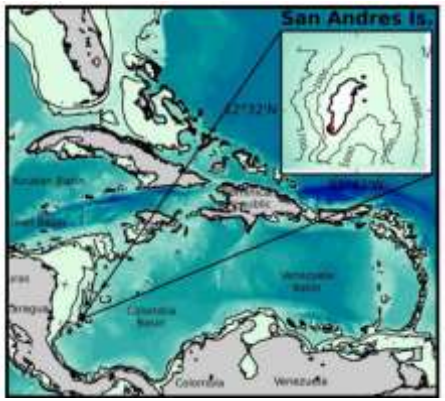
A. Devis-Morales et al. Renewable Energy 66 (2014) 759-769 // A.F. Osorio et al. Energy Policy 98 (2016) 713–724

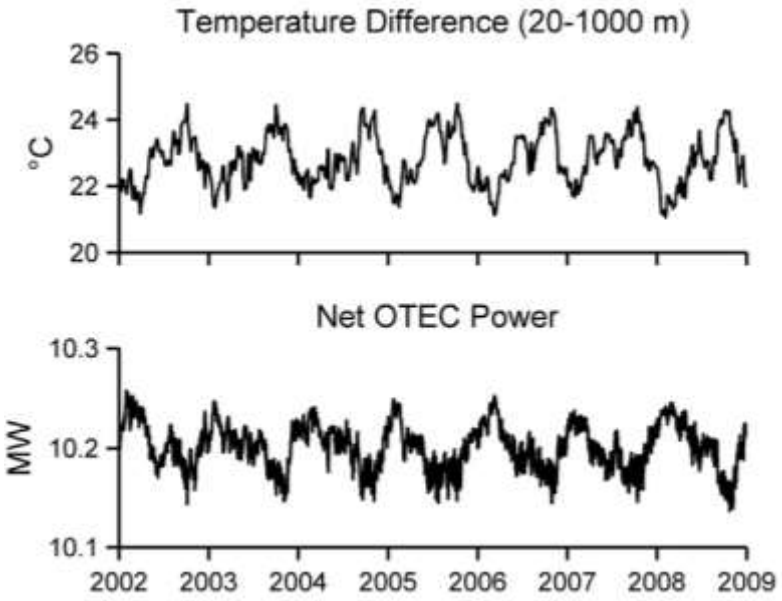
O. Alvarez-Silva, et al. Env. Sc. & Tech. Lett. 1(2014) 410.415 //
O. Alvarez-Silva, et al. Ren. Em.74 (2015) 737-748 //
O. Alvarez-Silva et al. Ren. Sust. En. Rev. 60 (2016) 1387–1395

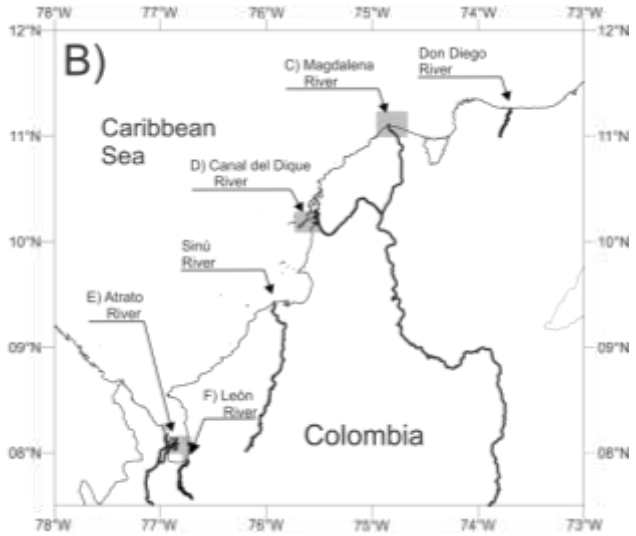
Based on:

- Thermal gradients
- Topographic features
- local infrastructure
- Social development
- Energy needs

San Andres Island was selected as the ideal location for an OTEC system.







River	mean	no-ENSO year		El Niño year		La Niña year	
		Dry season	Rainy season	Dry season	Rainy season	Dry season	Rainy season
Magdal.	620	556	632	638	632	634	626
Dique	6.4	6.4	8.6	1.6	3.6	8.8	8.8
Atrato	3.8	1.4	7.4	1.4	5.4	1.6	5.6
León	7.6	7.6	7.6	7.6	7.6	7.6	7.6
TOTAL	**638**						

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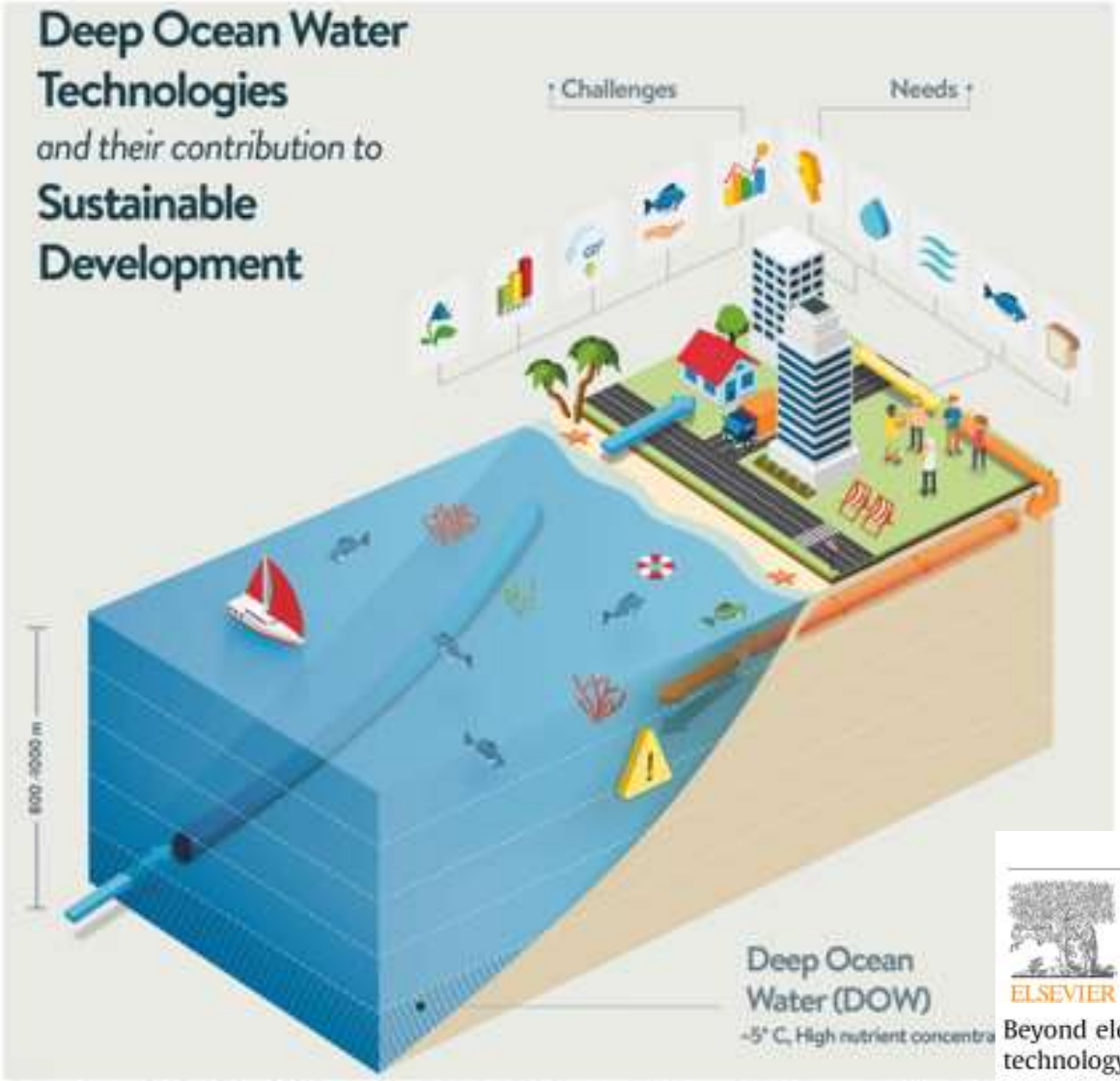
New Business models – Blue Economy
Ocean Technology Parks



Fuente: Jessica Arias-Gaviria (2019) Deep Ocean Water Technologies and their contribution to sustainable develo
Caribbean. Referencia: Laura Lucia Torres, www.holalula.com

- Energy (IRENA, 2014b)
- District Cooling (SWAC) (Makai., 2011)
- Desalination (Kalogirou, 2005)
- Greenhouse conditioning
- Aquaculture. (Yoza et al., 2010)
- Algae cultivation for biodiesel, cosmetic products, etc.
- Nutrients based industries (pharmaceutic and cosmetic).

Energy Policy 98 (2016) 713–724

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Beyond electricity: The potential of ocean thermal energy and ocean technology ecoparks in small tropical islands

Andrés F. Osorio [a,e], Jessica Arias-Gaviria [b,e,*], Andrea Devis-Morales [d], Diego Acevedo [c], Héctor Iván Velasquez [d,e], Santiago Arango-Aramburo [b,e]

FACULTAD DE MINAS

From LAB to the FIELD (pilot plant)

Test CENTER for Marine Energy
First field pilot of **salinity gradient** energy in Latin America:
The Magdalena River, Colombia

Researchers:

Universidad Nacional de Colombia: Andrés F. Osorio, Carlos Sánchez, Mateo Roldán

Universidad del Norte: Oscar Alvarez-Silva, Aymer Maturana, Leidy Solano

oceanicos
Investigación en oceanografía e ingeniería Costeras
UNIVERSIDAD DEL NORTE
UNIVERSIDAD NACIONAL DE COLOMBIA
Supported by:
El conocimiento es de todos
Minciencias

Challenges for Marine Energy - Colombia

1. **Country policy** regulation (CONPES, 3990, 4075..) and regional integration

2. Develop and incorporate local - **national capacities**.

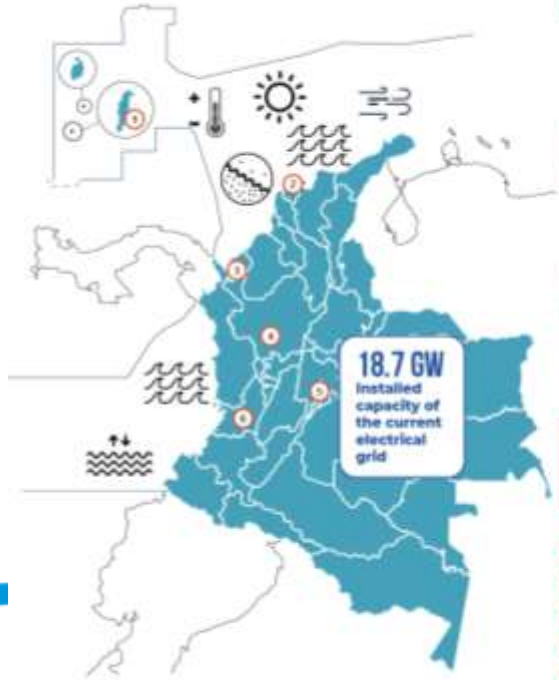
3. Actively involve **communities in solutions**. Real needs in the territories (energy, water, food, hydrogen, local industries..)

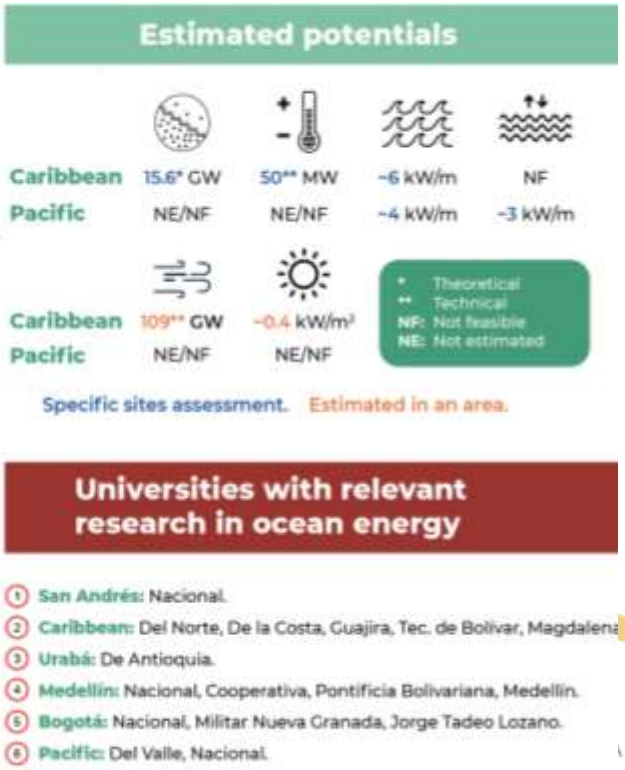
4. The ***marine resource*** has been study in the last 15y. We have explored resources (Salinity and Temperature) with a natural storage and higher capacity factors than traditional renewables (0.84 and 0.95).

5. Integrate energy solutions with nature-based solutions - Carbon Sequestration - **Blue Economy**

6. Develop **test and scale-up centers** for Latin America - Barranquilla Case (Colombia)

7. Develop **real test cases** (with local and national industries) integrating other needs (Ex. Desalination)





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GRACIAS!!!

TKS to local communities!!!

Andres F. Osorio

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