Neowave Energy

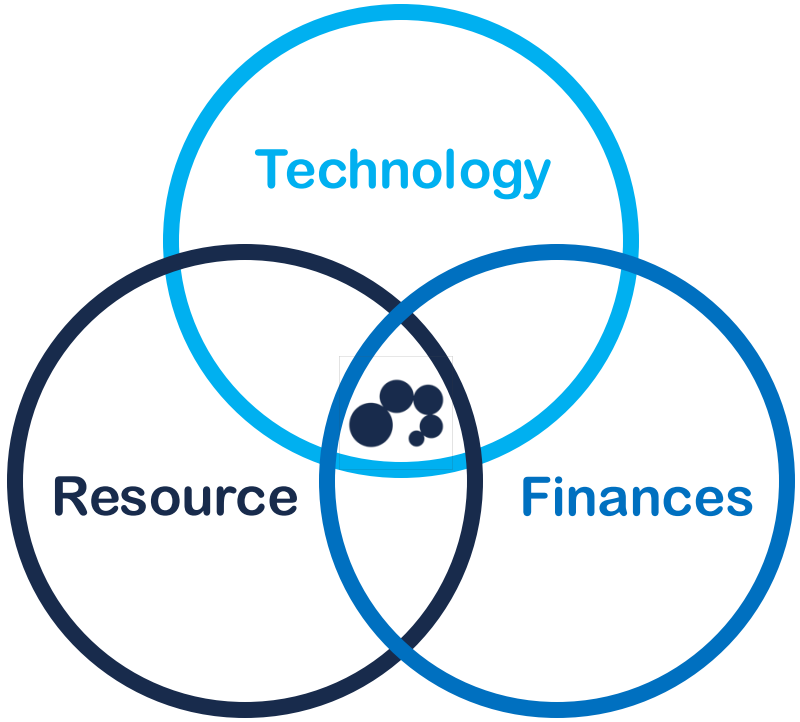
The Neowave wave energy converter: Development, simulations and testing.

@airamdphoto

Introduction

- World's population increasing.
- Electricity generation still depends on fossil fuels in remote areas.
- 29.000 TWh/year: Theoretical potential energy from waves [1].
- Close to the coasts, a practical availability rounds the 2.900 TWh/year.

- Principles of balance for the development of any renewable energy technology [2]:



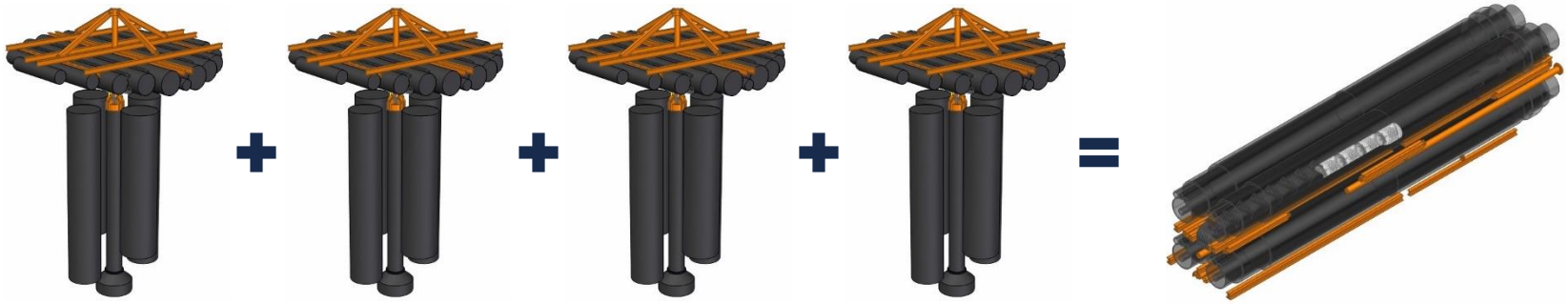
[1] IRENA, "Innovation Outlook: Ocean Energy Technologies" Dec. 2020. [Online] Available: https://www.irena.org/publications/2020/Dec/Innovation-Outlook-Ocean-Energy-Technologies
[2] G. Lavidas, "Selection index for Wave Energy Deployments (SIWED): A near-deterministic index for wave energy converters" Journal of Energy, vol. 196, 2020.

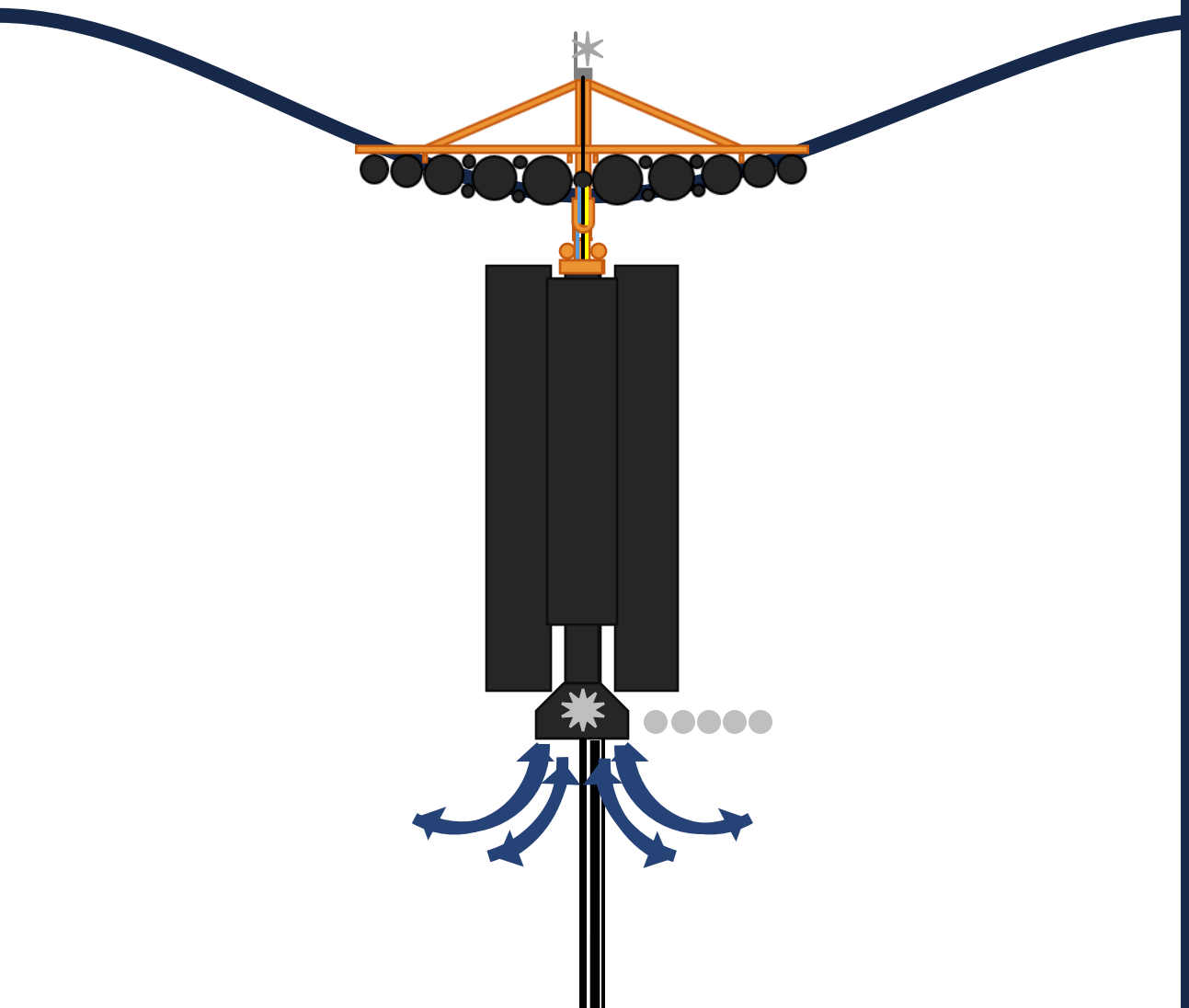
Technical problems

- Rotary or linear electromagnetic generators need high speed to create electricity.
- Gears, gear racks, cams, pulleys, chains, bands, or oils, are used for power transmission and/or speed increase, requiring more maintenance labors and increasing failure risk.
- Current wave energy projects use complex technologies, special parts, or new manufacturing processes that are not available in some regions, isolated communities, or developing countries.
- Floating non-standard structures use rigid volumetric geometries that need extra space for storage or expensive logistics.
- Financial disadvantages.

Neowave

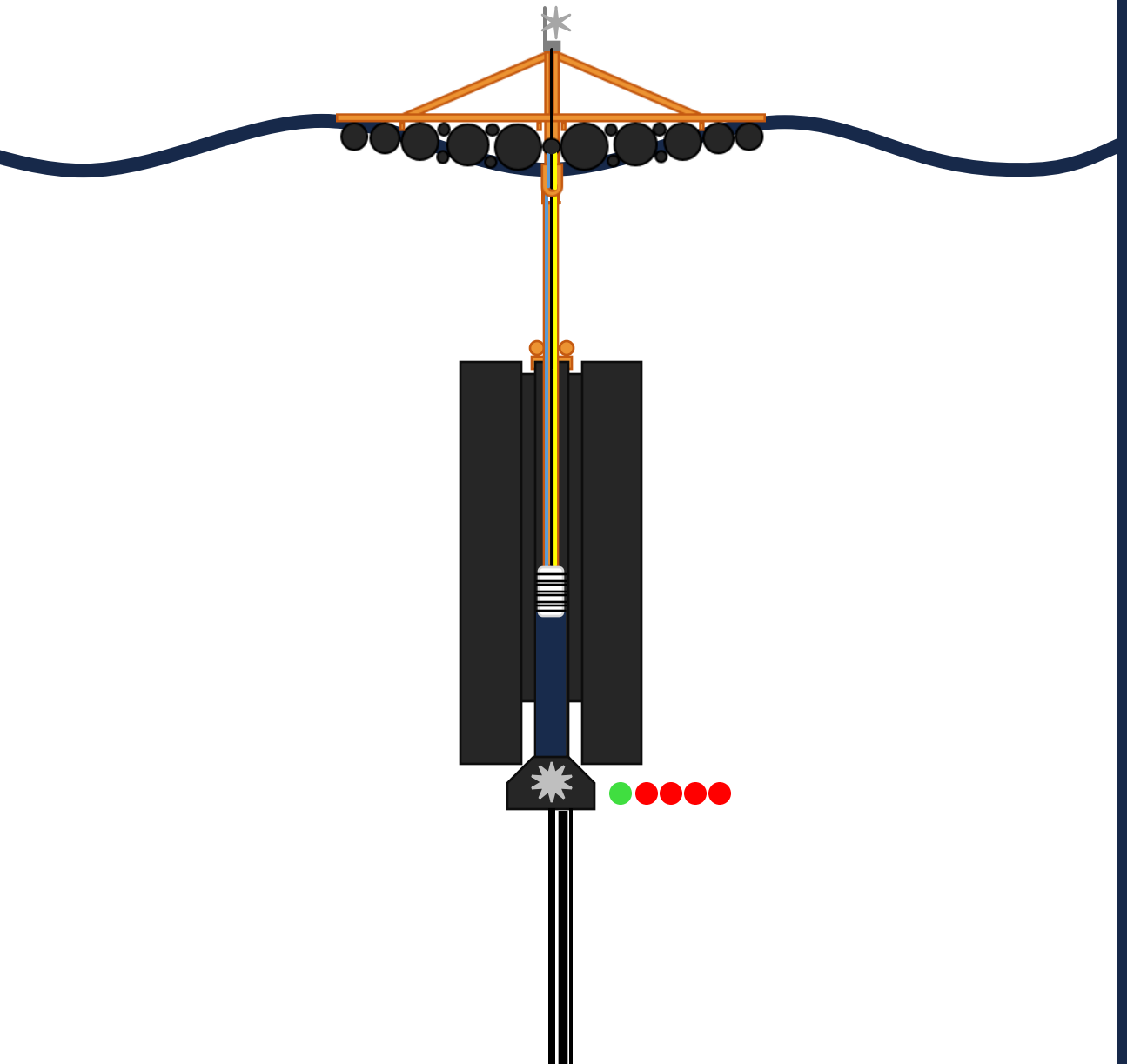
- A ‘new way’ to obtain energy, inspired by the breathing dynamics
- Basic, standard, or industrialized components, with traditional manufacturing.
- Less dynamic parts and only seawater for power transmission.
- No gears, gear racks, cams, pulleys, chains, or bands for speed increase.
- Remotely operated systems for control (ROCS) and maintenance (ROMS), patented.
- Simple, for easy installation, performance, and pieces change.
- Scalable, for different applications.
- Stackable, for better logistics:





How it works?

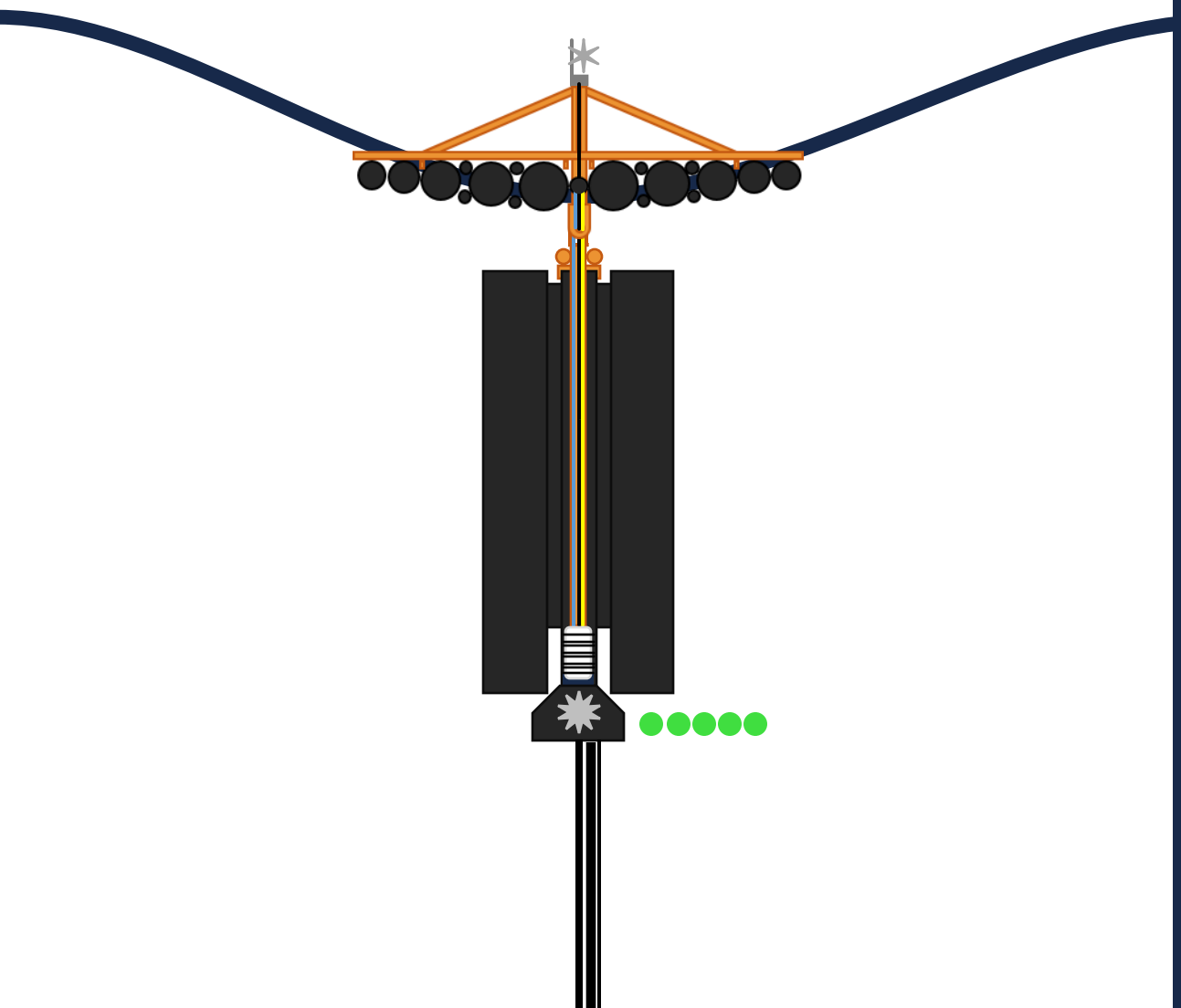
- Connected to an umbilical cable that sends energy and receives signals.
- It takes and expels sea-water.
- Same rotational direction for bidirectional generation.
- By-pass pipes for sea-water deviation during other conditions.
- The PTO is subdivided into more than one generator.



ROCS

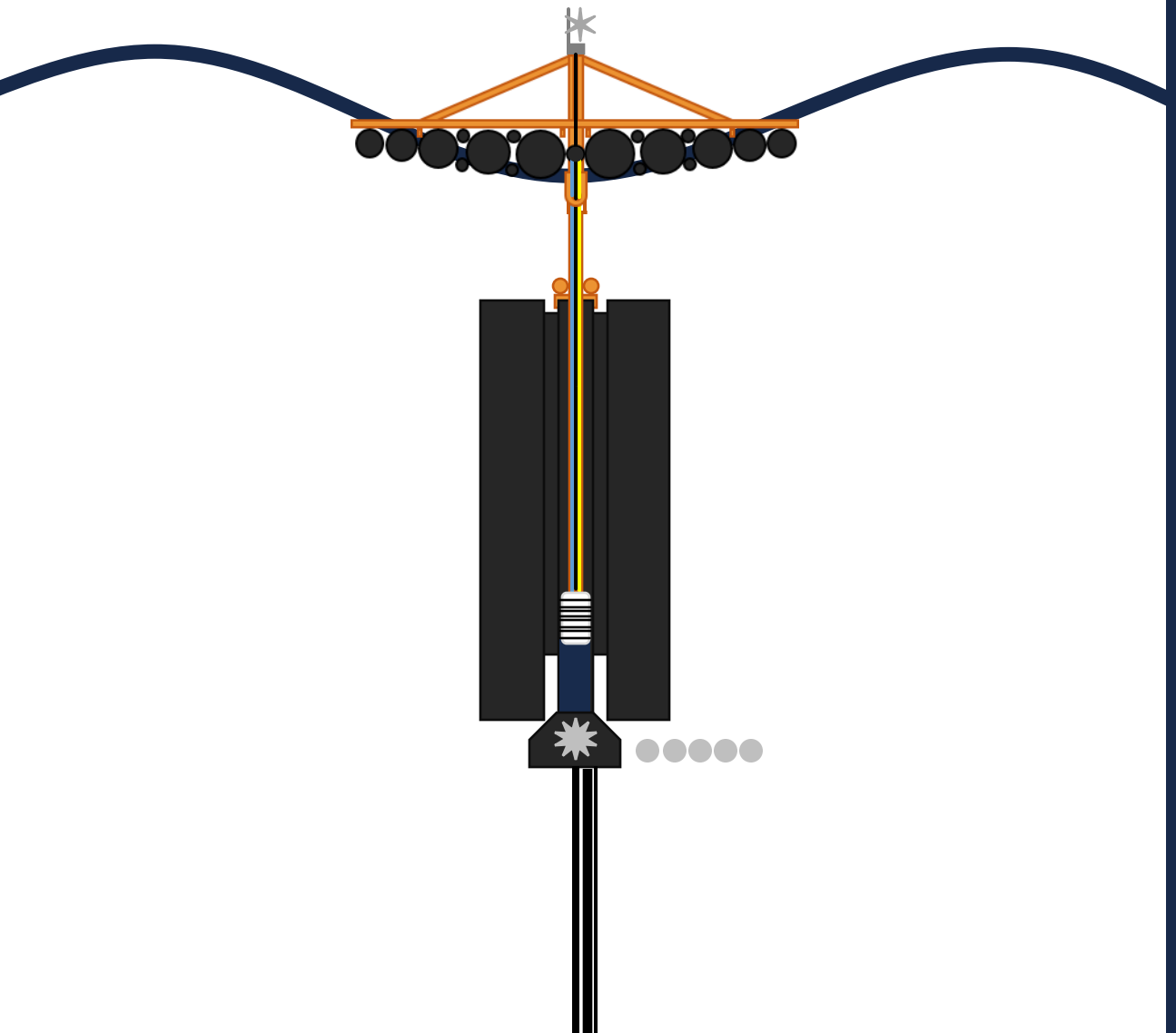
PTO's geometry adaptation, similar to a wind turbine blade's angle or cross-section change.

- One or more generators are activated for low wave energy densities.
- The rest of the generator's inlets are closed.
- All by-pass pipes, closed.



ROCS

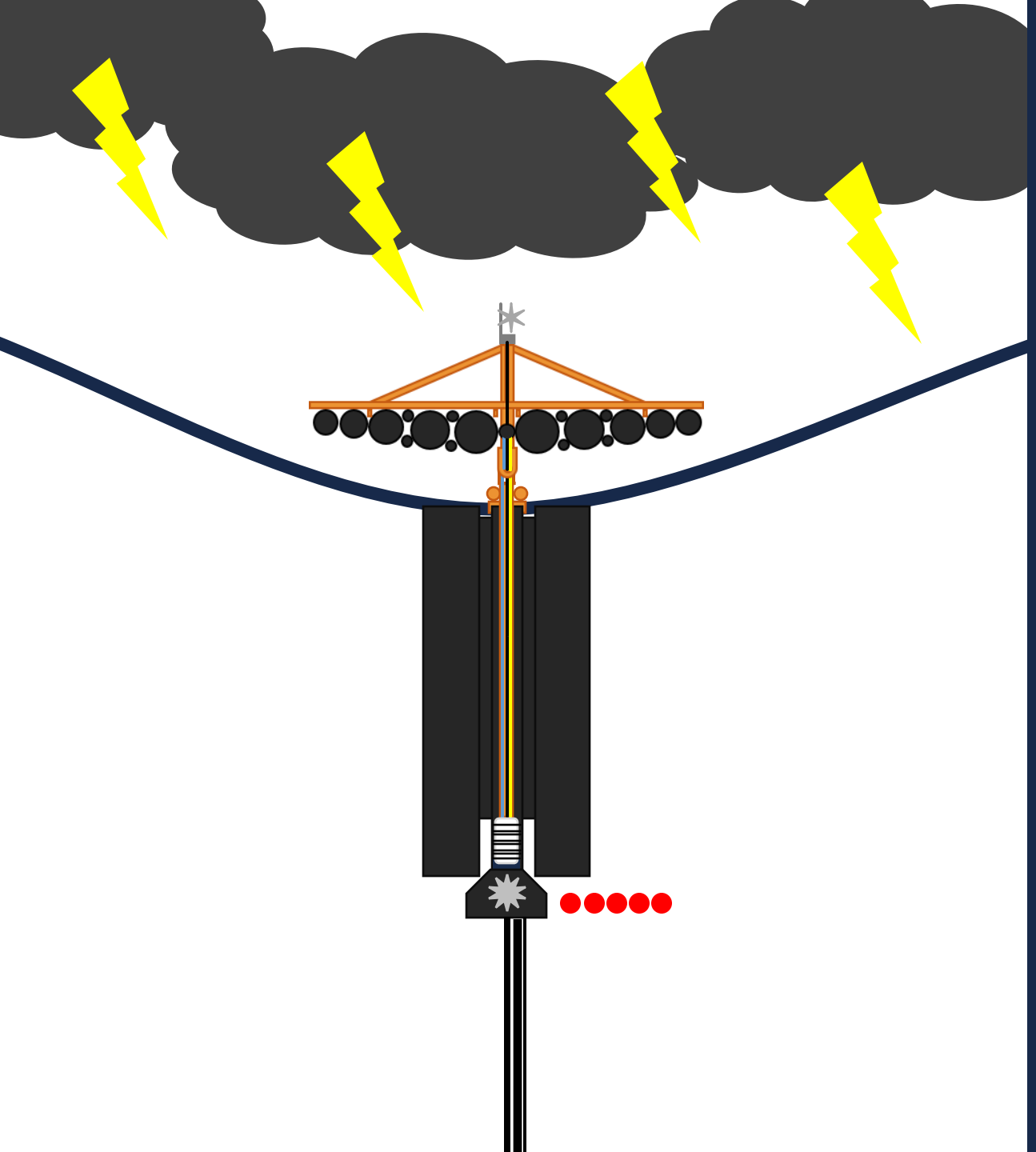
- All generators are activated for high wave energy densities.
- All by-pass pipes are closed.



ROCS

Survivor/Maintenance mode:

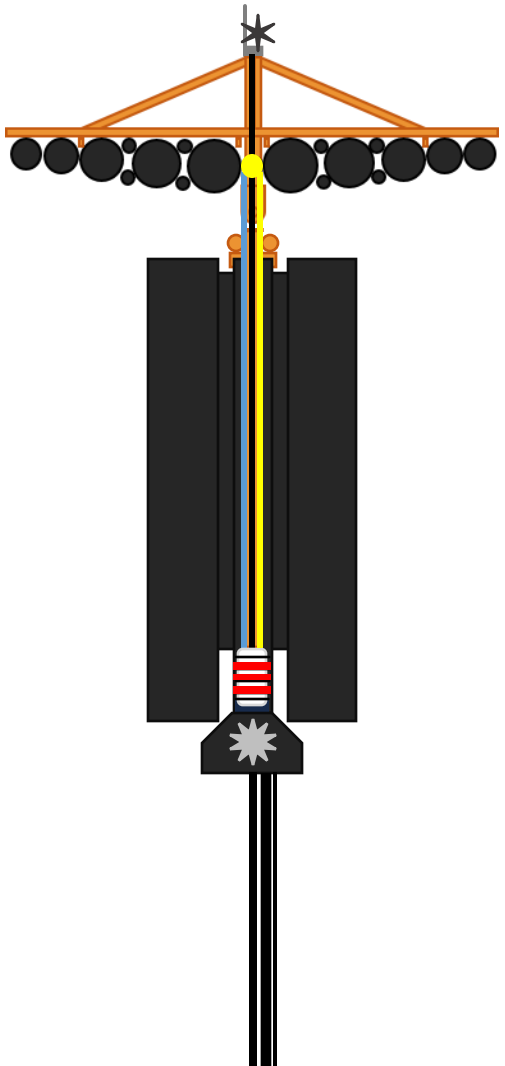
- By-pass pipes are open.
- All generators' inlets are closed.
- Water flows but without generation.



ROCS

Storm mode:

- By-pass pipes are closed.
- All generators' inlets are closed.
- Water doesn’t flows.



ROMS

Lubrication and seals change, reducing visits and increasing device's time life.

- A wind generator and a battery cumulate energy as backup.
- Tanks are previously filled with a bio-lubricant.
- Pressurized water from piston increases lubricant's pressure, flowing through the seals.
- Seals change mechanism.

First year LCoE, $/MWh, and Finances

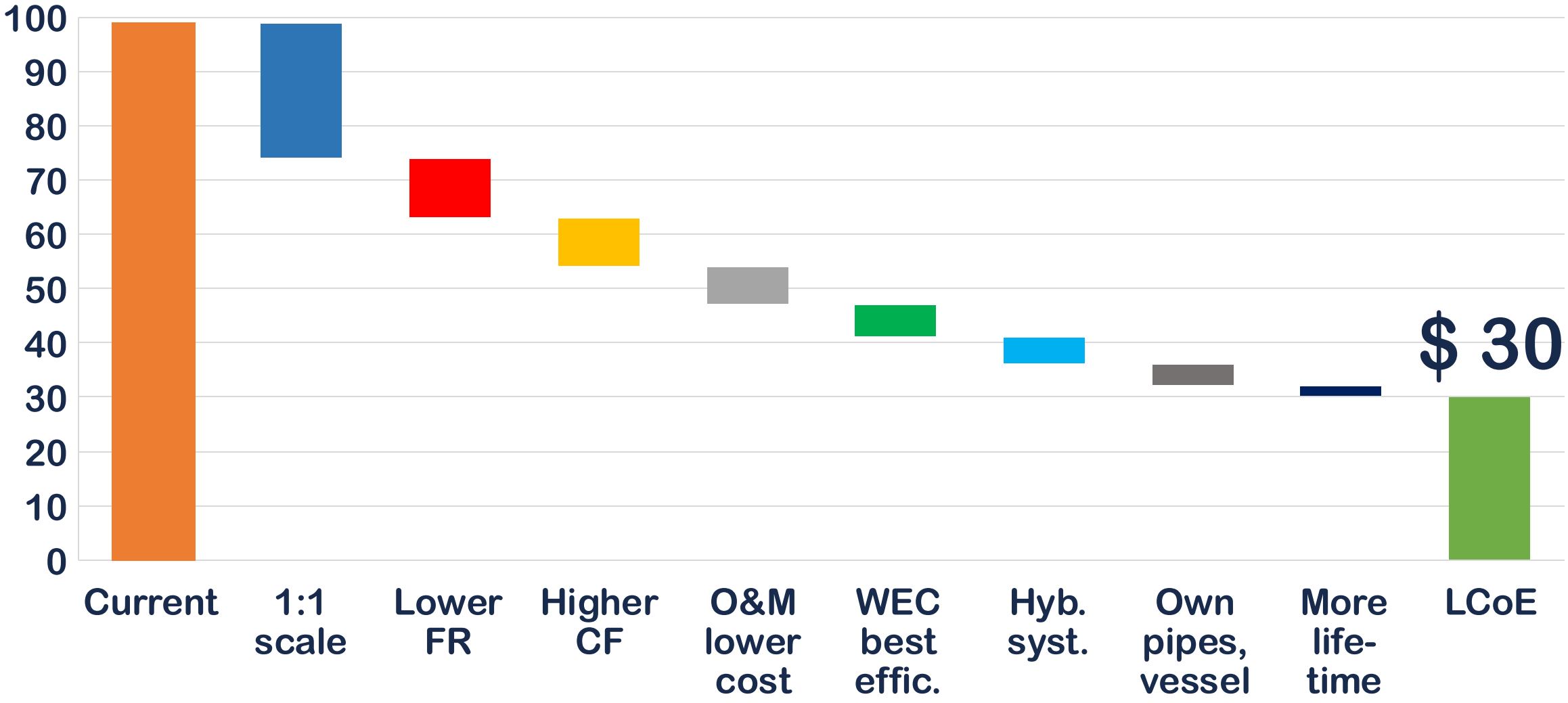
Profit margin:
20 %

Reference:
164 $/MWh

ROI, BEP @ 1:2:
8 %, 13 yr.

ROI, BEP @ 1:1:
11 %, 9 yr.

Potential reductions, $/MWh



Social and Environmental

- No gases emissions.
- No composite hulls.
- Coastline, coral, and mangrove protection.
- Desalinization.
- Aquaculture and pisciculture.
- Hand to hand with communities.

Simulations

- Create a reliable and efficient numerical platform using WEC-Sim to model the Neowave's WEC and PTO device.
- In-progress.

Task 1.
Assessment of previous work:

- Centers of mass.
- Inertia moments.
- PTO details.
- Mooring properties.

Task 2.
Initial WEC-Sim model:

- Linear hydrodynamics.
- CUBIT meshing.
- WAMIT and Capytaine.
- Simscape blocks.

Task 3.
Advanced PTO dynamics:

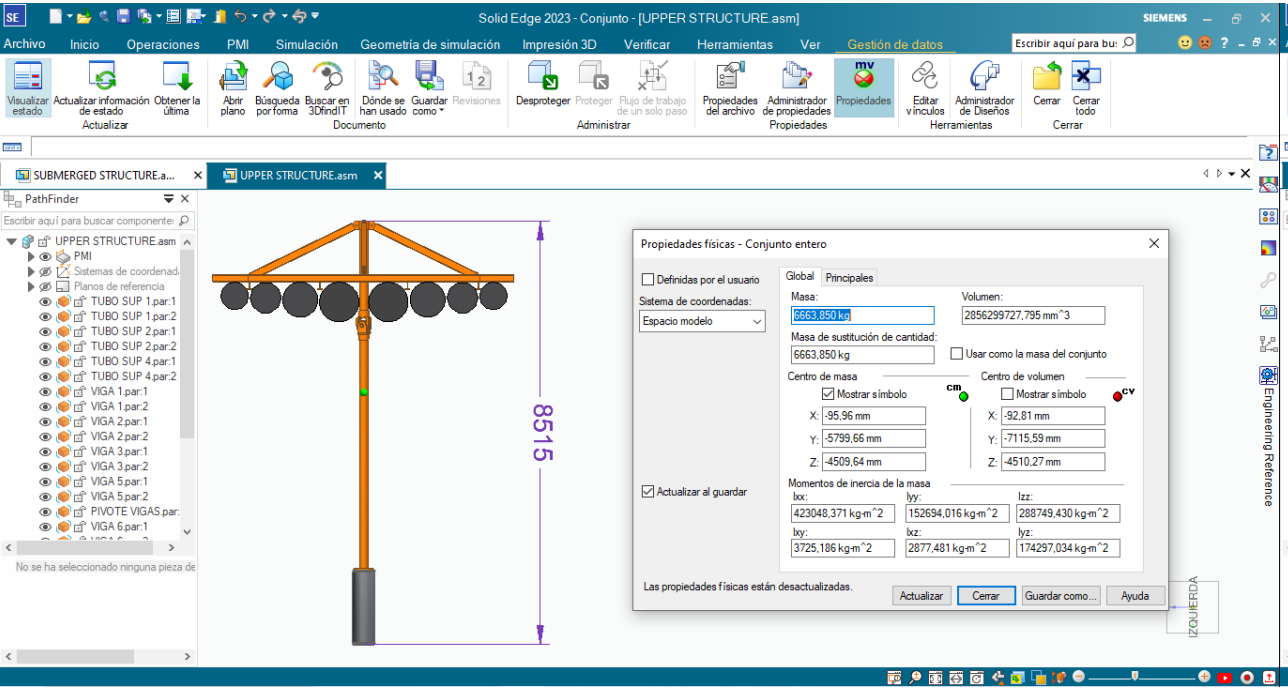
- Nonlinear effects.
- PTO interaction with the WEC.

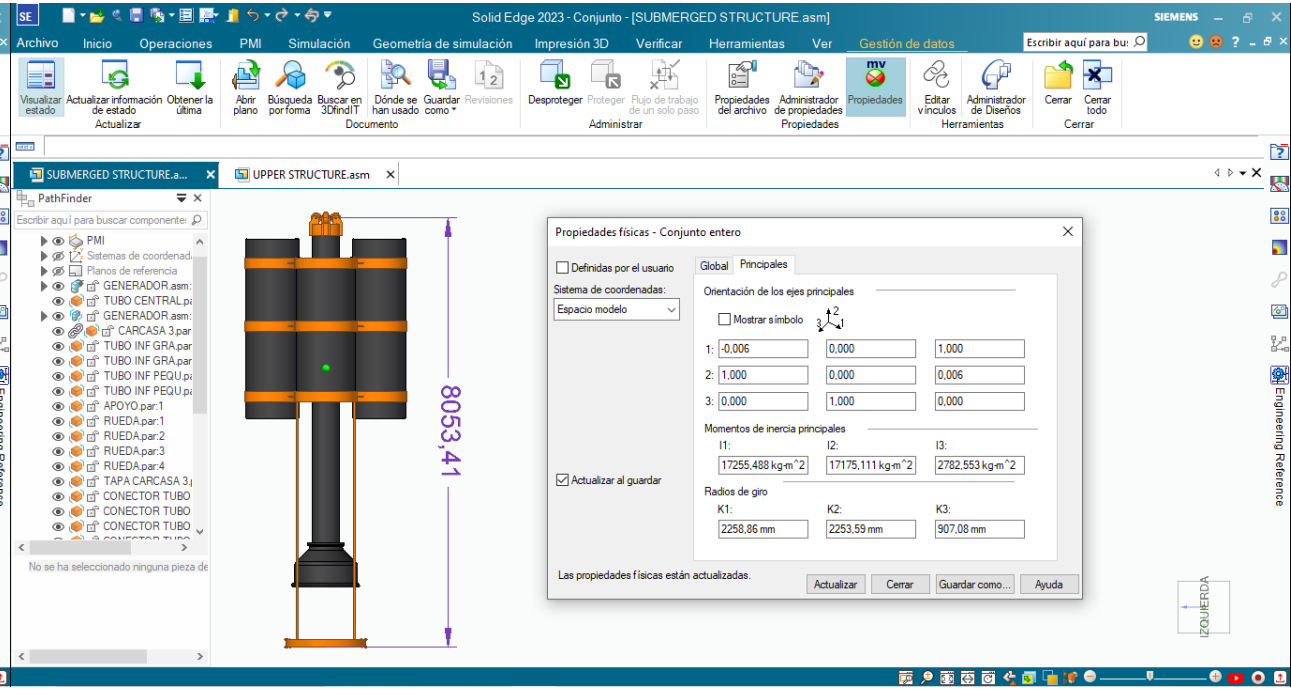
Task 4.
Interface implementation for future parameters analysis.

Task 5.
Analysis of results and processing

Simulations

- Teamer's recipient, in collaboration with Sandia National Laboratories.
- Center of mass and inertia properties from Siemens's Solid Edge software.





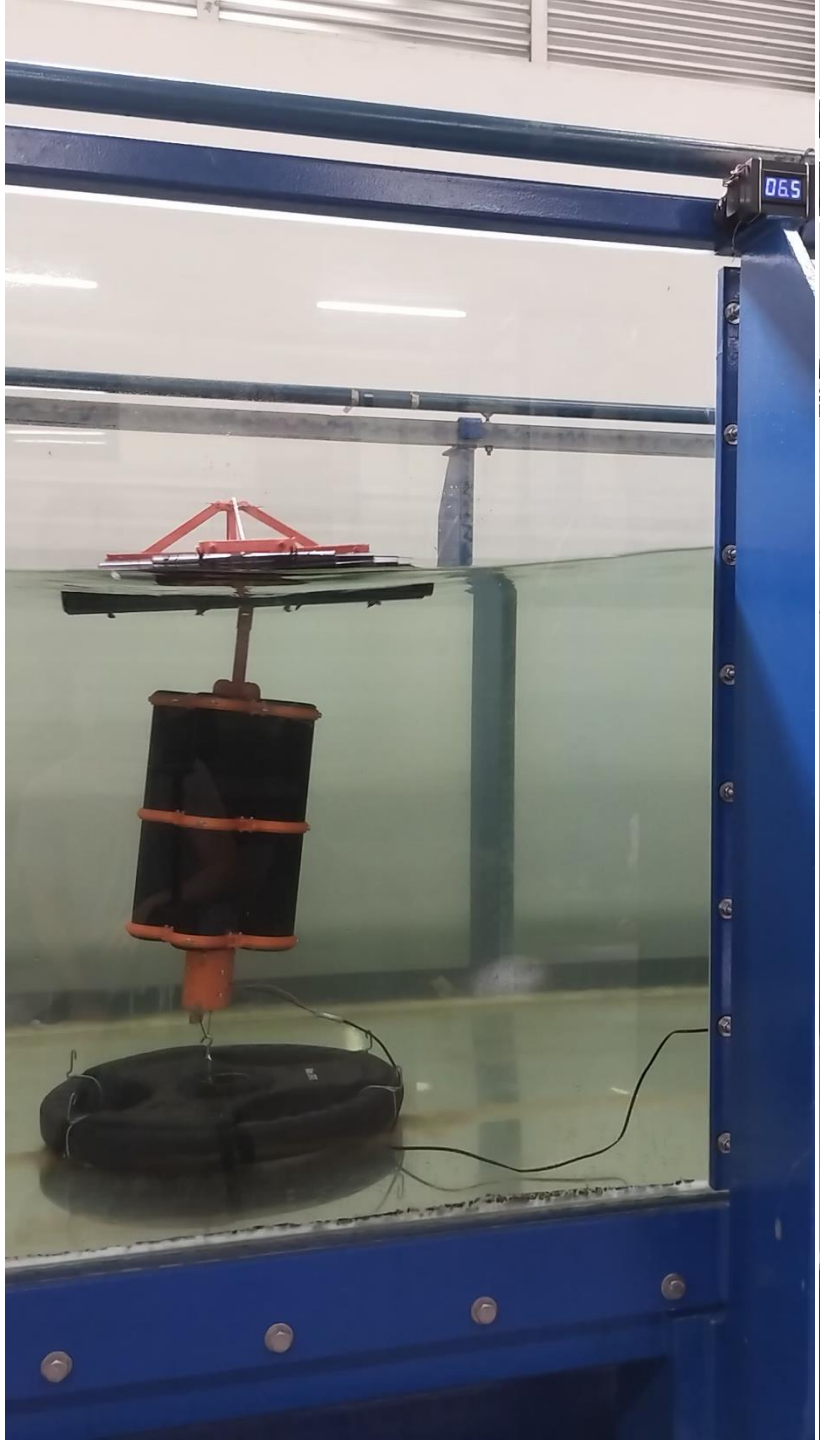
Testing

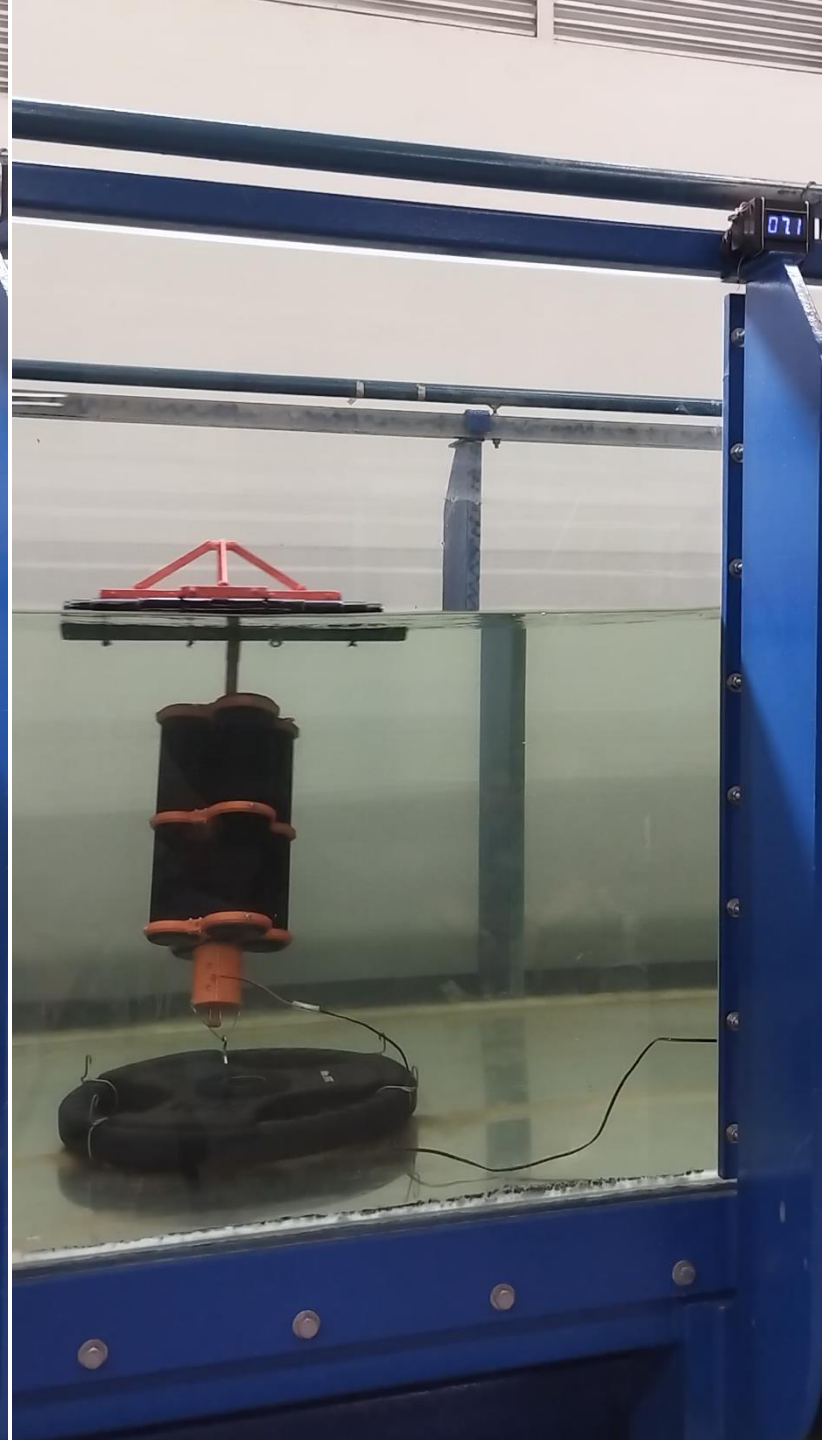
- Version 2.0
- 1:30 scale.
- Home made construction.

- Wave height: 7,5 cm.
  Wave period: 1 s.

- Wave height: 15 cm.
  Wave period: 2 s.

- Hydrodynamic shapes considered.





Timeline

CATAPULT Offshore Renewable Energy

Interreg North-West Europe OPIN

UNIVERSIDAD NACIONAL DE COLOMBIA

TRL 1-2 2020	TRL 3 2021	TAP 2022	Patents 2022 - 2024	TRL 4 2025
USD 8.000	USD 9.000	USD 5.000	USD 15.000	USD 30.000

TEAMER Testing & Expertise for Marine Energy

Neowave Energy

Simulations 2025	TRL 5 Bench testing. Simulations 2026 – 2027	TRL 6 Open water scaled pilot 2027 – 2028	TRL 7-8 Open water scale device 2029	TRL 9 2030
USD 120.000	USD 0,5 M	USD 1 M	USD 3 M	Pre-sales

Team

José Montoya - Mechanical Engineer.

- New materials, automatics, design, and cardiovascular dynamics research.
- 16 years in composite materials and renewable energies development and entrepreneurship.
- PV modules' manufacturer current sales manager for Hispanic America.

Shalom Scott - Physics Engineering.

- Corrosion and bio-foiling analysis.
- Manufacturing.

oceanicos
Investigación en oceanografía e Ingeniería Costeras

Conclusions and thanks

- Greater opportunities also in developing countries.
- Proof of concept validated, getting a TRL 4.
- More options for LCoE potential reductions.
- Less initial investment, reducing financial costs and increasing confidence.

- We can't alone… Looking for local or international partners to continue with project's next stages.

- Thank you!

Neowave Energy

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