Neowave Energy

The Neowave wave energy converter: Technical and financial approach.

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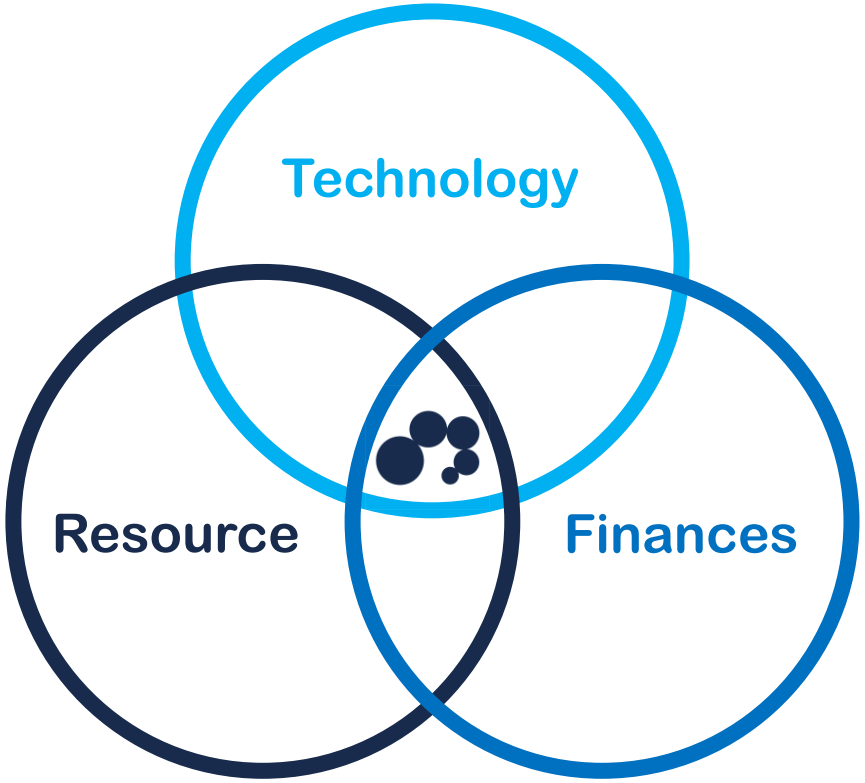
- Mecanical Engineer, UPB – Medellín, Colombia.
- Research groups participations: New materials, Automatic+Design y Cardiovascular Dynamics.
- 12 years in new composite materials design and manufacturing processes entrepreneurship.
- 4 years in renewable energies development: Wave, BIPV solar, Floating solar, Biomass and Human kinetics.

Introduction

- The world population has increased the energy demand.
- Electricity generation still depends on fossil fuels in some areas.
- Waves have a 29.000 TWh/year theoretical potential energy [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 problem

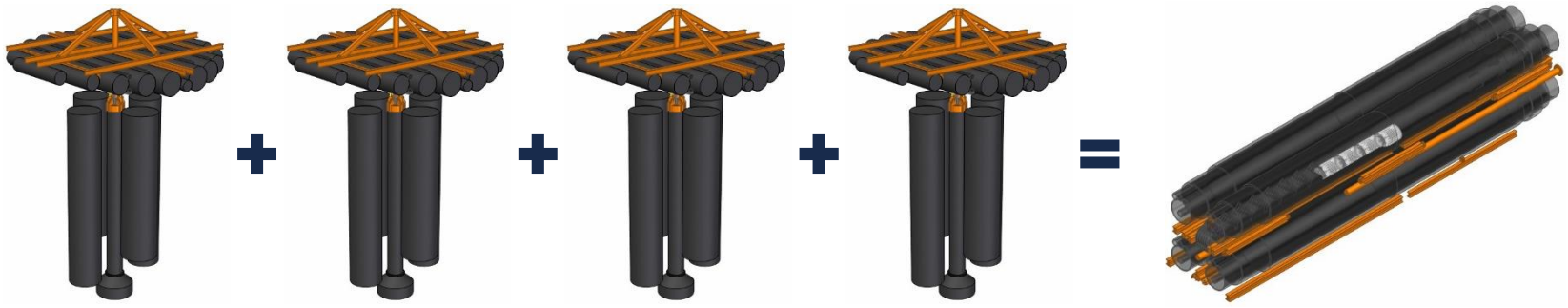
- Rotary or linear electromagnetic generators need high speed to create electricity.
- Gears, gear racks, cams, pulleys, chains, bands, or oils, are used for power transmission and/or speed increase, requiring more maintenance labor and increasing failure risk.
- Current wave energy projects use complex technologies, special parts, and 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 and expensive logistics.

Neowave

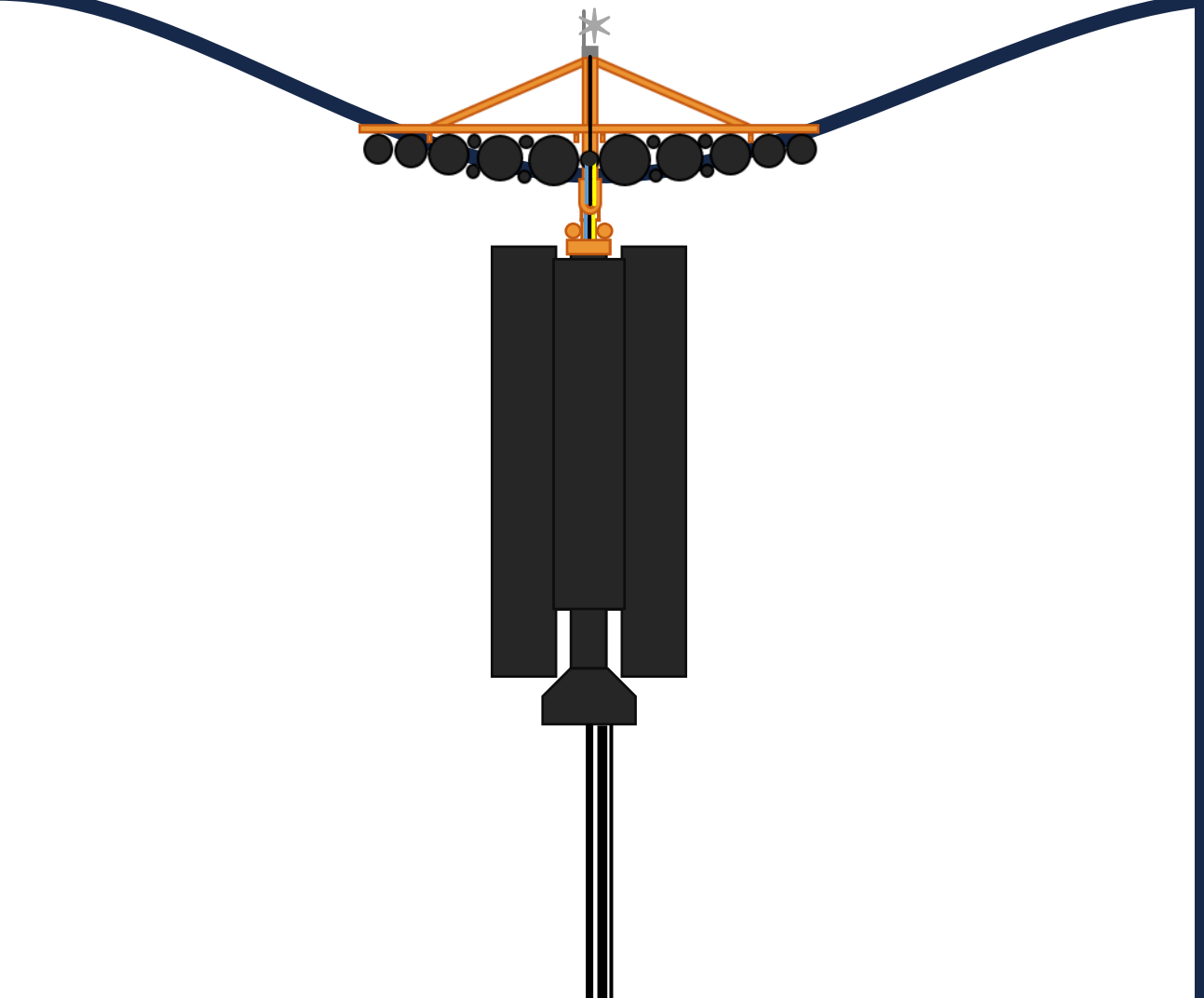
- A ‘new way’ to obtain energy from waves, inspired by the breathing dynamics.
- Point absorber type, tethered to the seabed.
- Basic, standard, industrialized, and commercial components.
- Special parts’ fabrication by suppliers with traditional manufacturing technologies.
- Less dynamic parts and only seawater as fluid for power transmission.
- No gears, gear racks, cams, pulleys, chains, or bands for speed increase.
- Remotely operated systems for control (ROCS), and maintenance (ROMS) designed.

Neowave

- Dismountable design for pieces change.
- Scalable design: From small units for powering sensors to big ones in energy parks.
- Stackable design: Four 1:2 scale units in one 40’HQ container, up to 35 MWh per month, and better logistics:



Scale:	Power:	Efficiency:	Cap. factor:	Diam.:	Weight:	Life time:
1:2	32 kW	62 %	+30 %	6 m	8 ton	30 yr.



How it works?

- Lateral vertical floats create buoyant force that strains the lower body.
- The upper body rises and falls along with the change in wave height.
- It takes and expels sea-water, exciting generators.
- Connected to an umbilical cable that sends energy and receives signals.
- Bidirectional generation.

Prototype

- 1:30 scale.
- Home made construction with local basic materials and processes.
- Water level change and lateral force simulator.

Remotely operated systems

- The Remotely Operated Control System - ROCS is designed to control de device changing the internal PTO geometry, similar to a wind turbine blade angle or cross-section change. It helps to get more energy from waves in different conditions, to keep a survivor mode for maintenance labor, and to turn off in storms.

- The Remotely Operated Maintenance System - ROMS allows remote lubrication and seals change, reducing regular visits to the place and increasing device's time life.

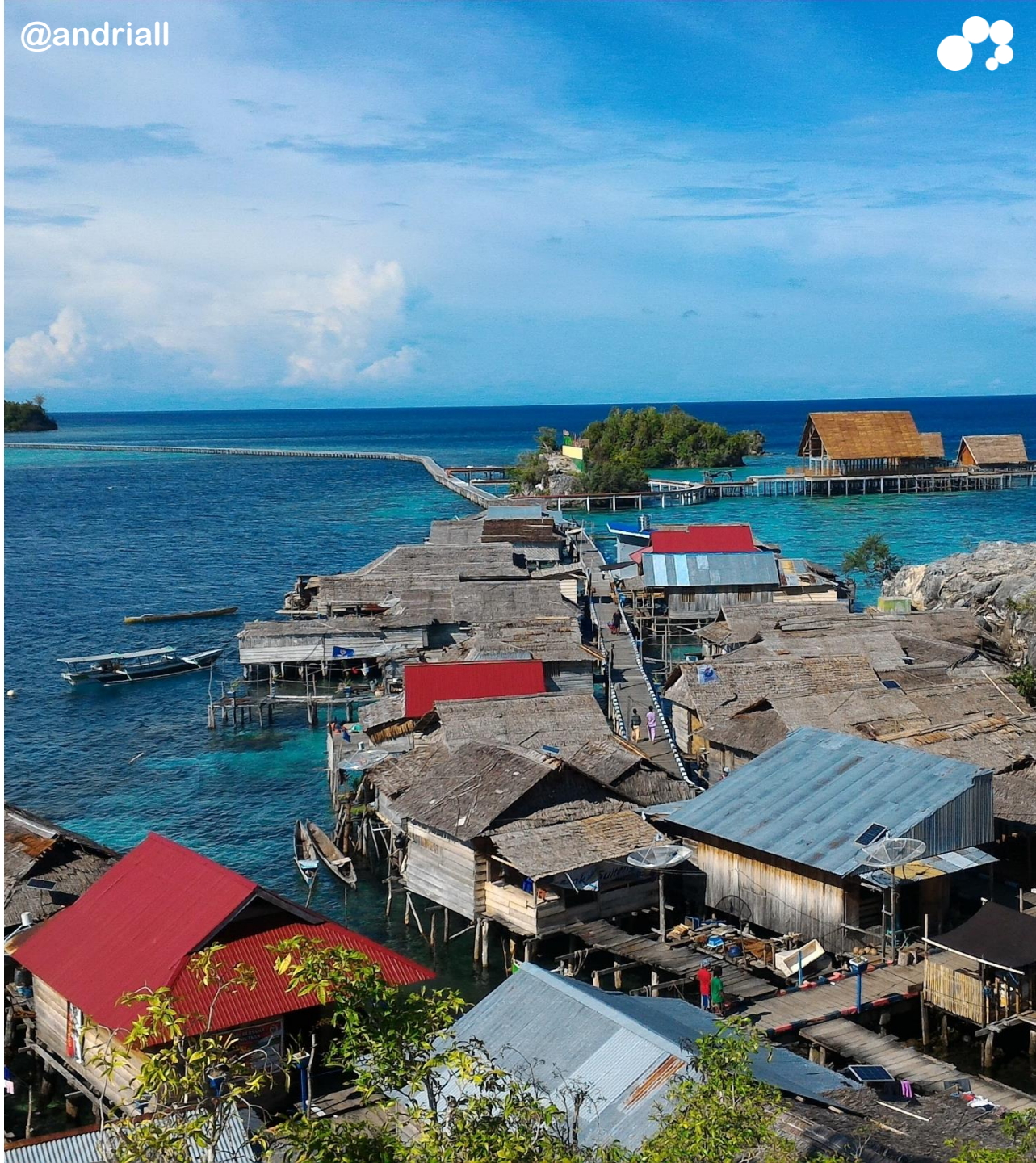
- Two patent-pending processes.

Environmental

- No composite materials: All recyclable or reusable.
- Coastline, coral and mangrove protection.
- Design variation for floating plastic recollection (skimmer).
- Design variation for a water pump.

Social

- Desalinization
- Energy and food safety.
- Hybrid projects with aquaculture, or pisciculture.
- Simple design for installation, mantenance or control labours hand to hand with communities.



LCoE simplified formula [3]

$$LCoE = \frac{FR \times IC + LRC + O\&M}{AEP}$$

Where:
FR: Financing Rate, %.
IC: Initial Capital (CapEx), $.
LRC: Levelized Replacement Cost, anual, $.
O&M: Operations and Maintenance costs (OpEx), anual, $.
AEP: Annual Energy Production, MWh.

[3] NREL, “Simple Levelized Cost of Energy (LCOE)” Jun. 2010. [Online] Available: https://www.nrel.gov/analysis/tech-lcoe-documentation.html

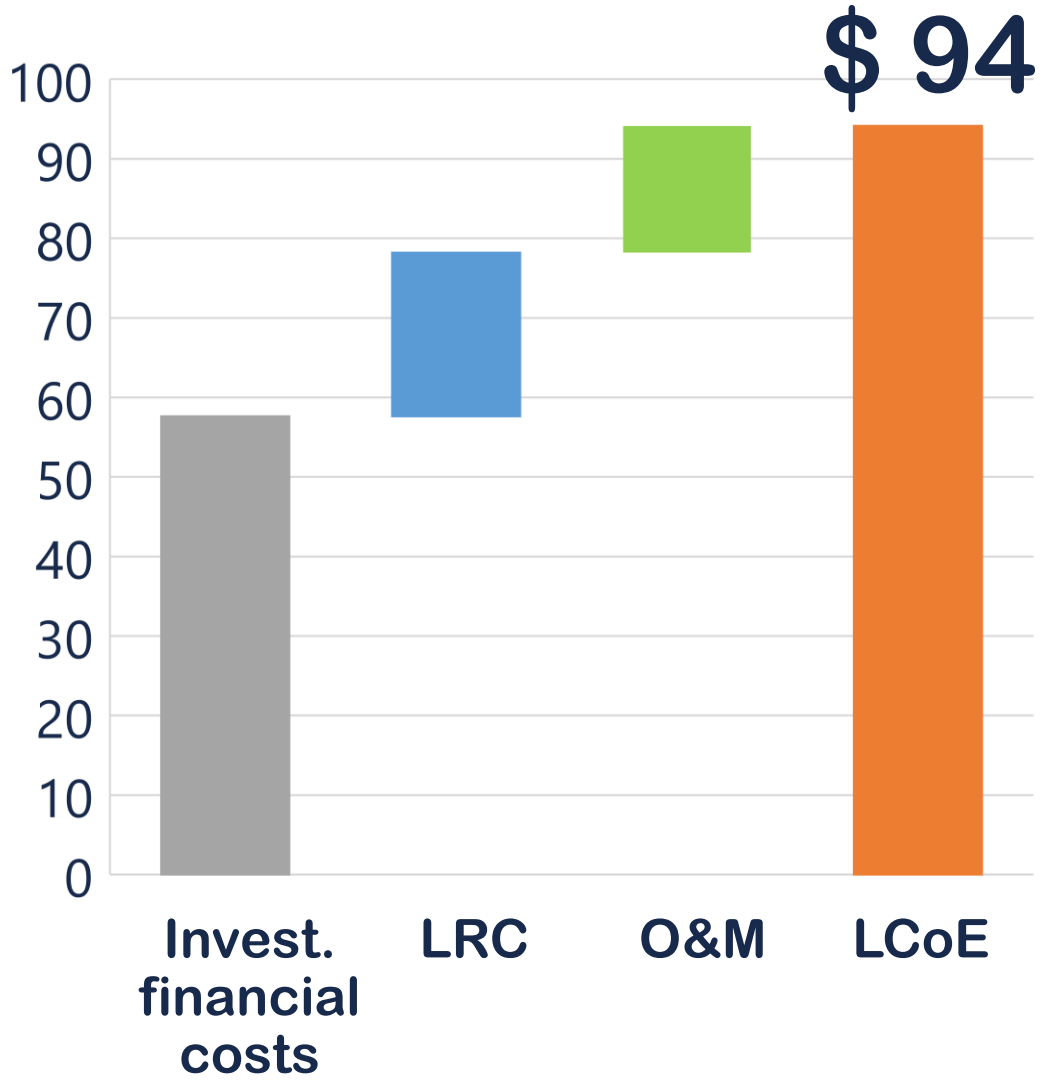
First year LCoE, $/MWh, and Finances

Profit margin:
20 %

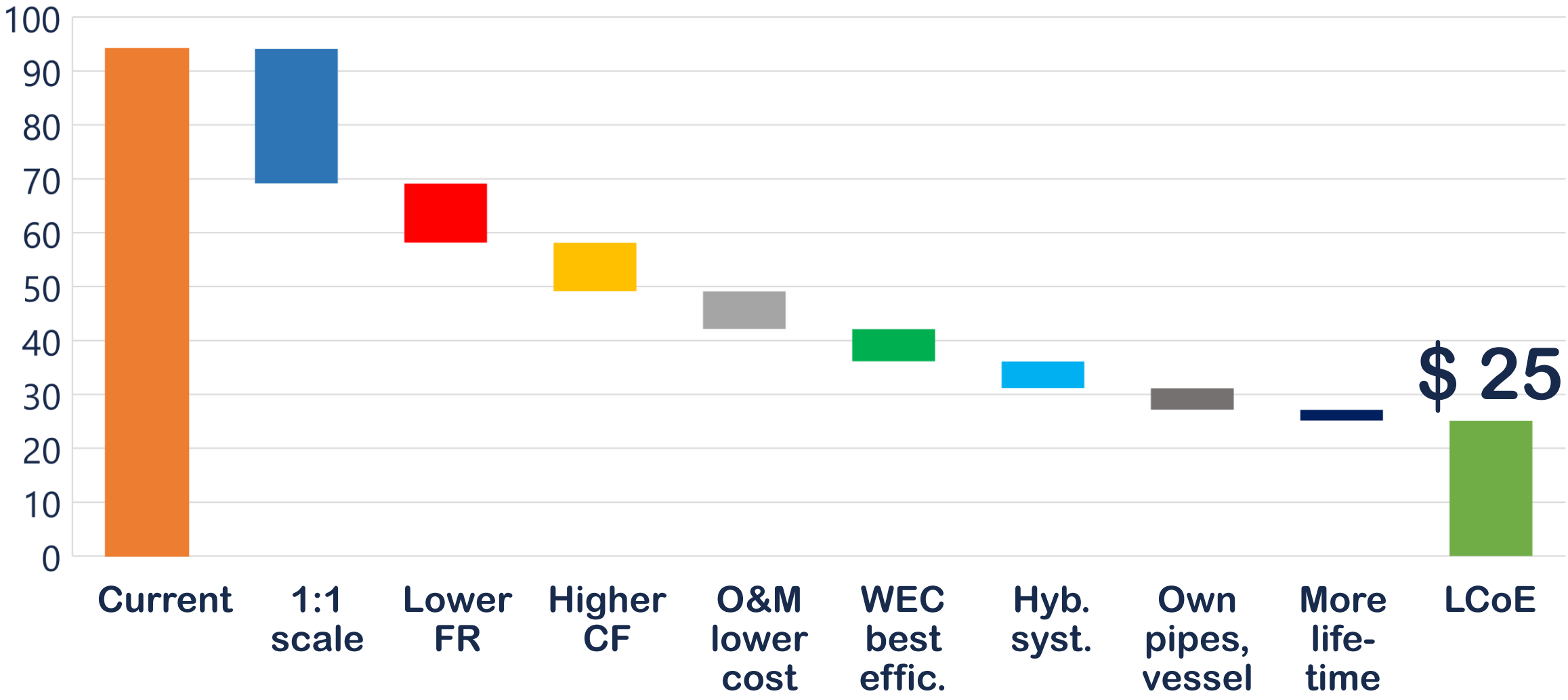
Reference:
205 $/MWh

ROI, BEP @ 1:2:
15 %, 6 yr.

ROI, BEP @ 1:1:
20 %, 5 yr.



Potential reductions, $/MWh



Conclusion and thanks

- Proof of concept validated with a functional 1:30 scale prototype, getting a TRL 3.
- Its simplicity requires less initial investment, reducing financial costs and increasing confidence.
- More options for LCoE potential reductions.
- Greater opportunities also in developing countries.
- Future work in computational simulations, bench testing, wave tank testing, and field testing, previous to commercial stages.
- I can't alone… Looking for partners to continue with the project.

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