ENERMAC
Energías Renovables y Eficiencia Energética
Desarrollo Sostenible de África Occidental e Islas de la Macaronesia

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(MAC/1.1a/117)

## Challenges in marine energy in the short-term

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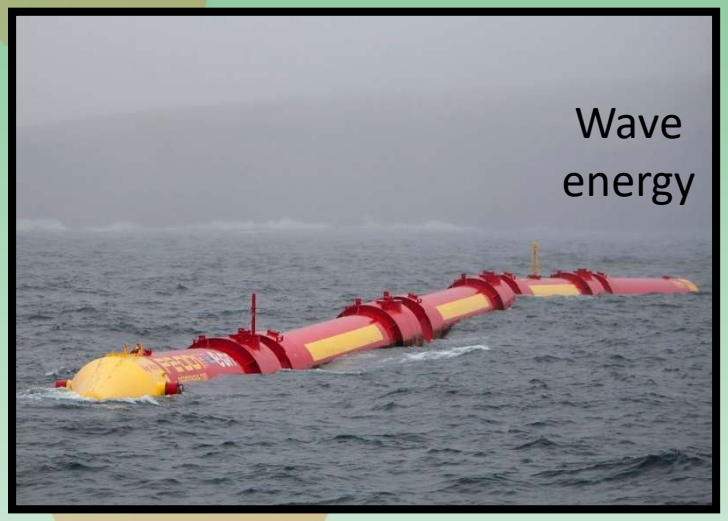
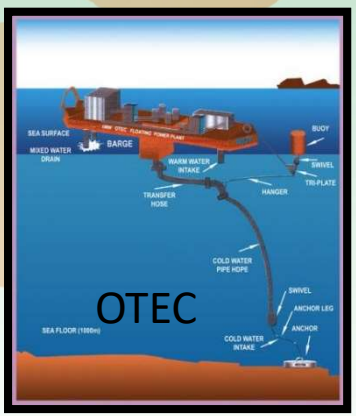
Gobierno de Canarias

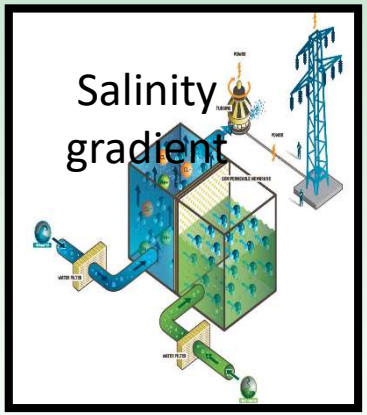
Las Palmas de Gran Canaria, 29th October, 2019

# Types of marine energy technologies

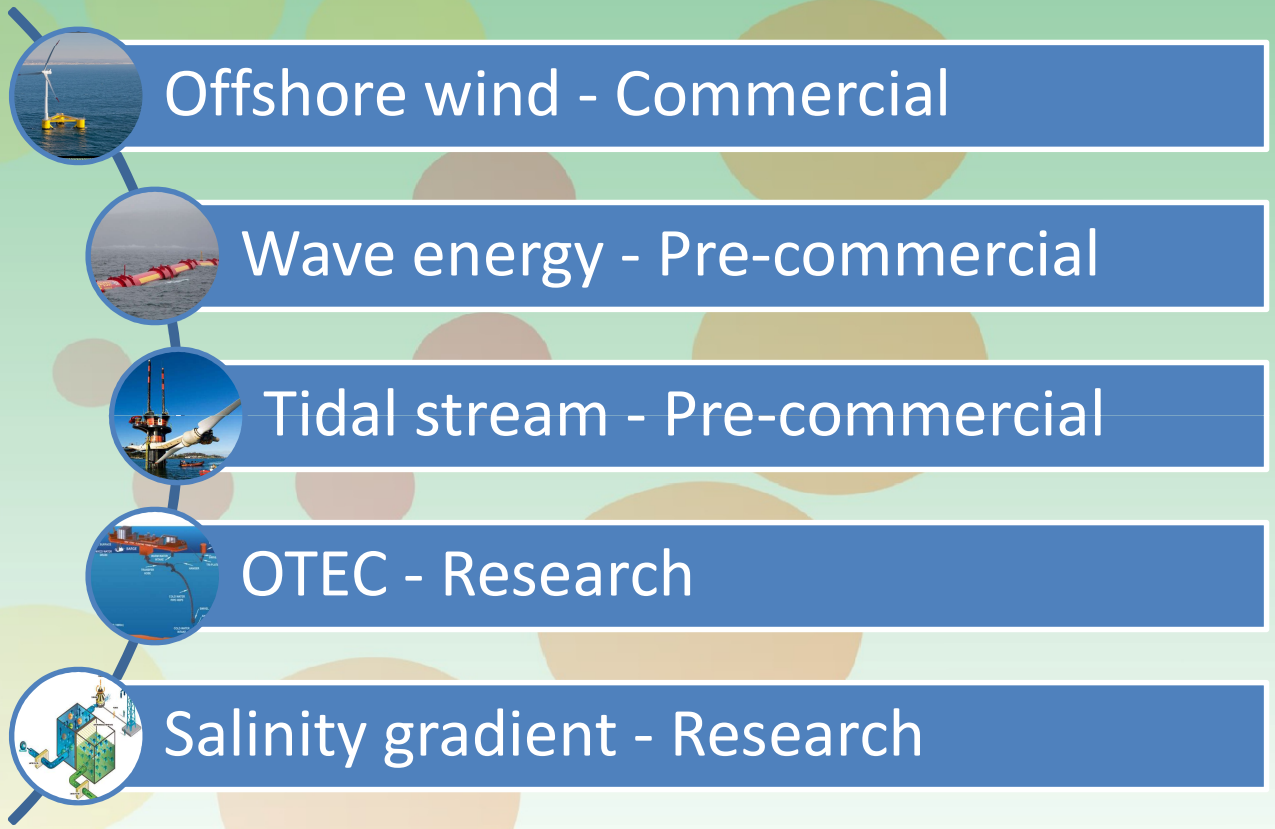





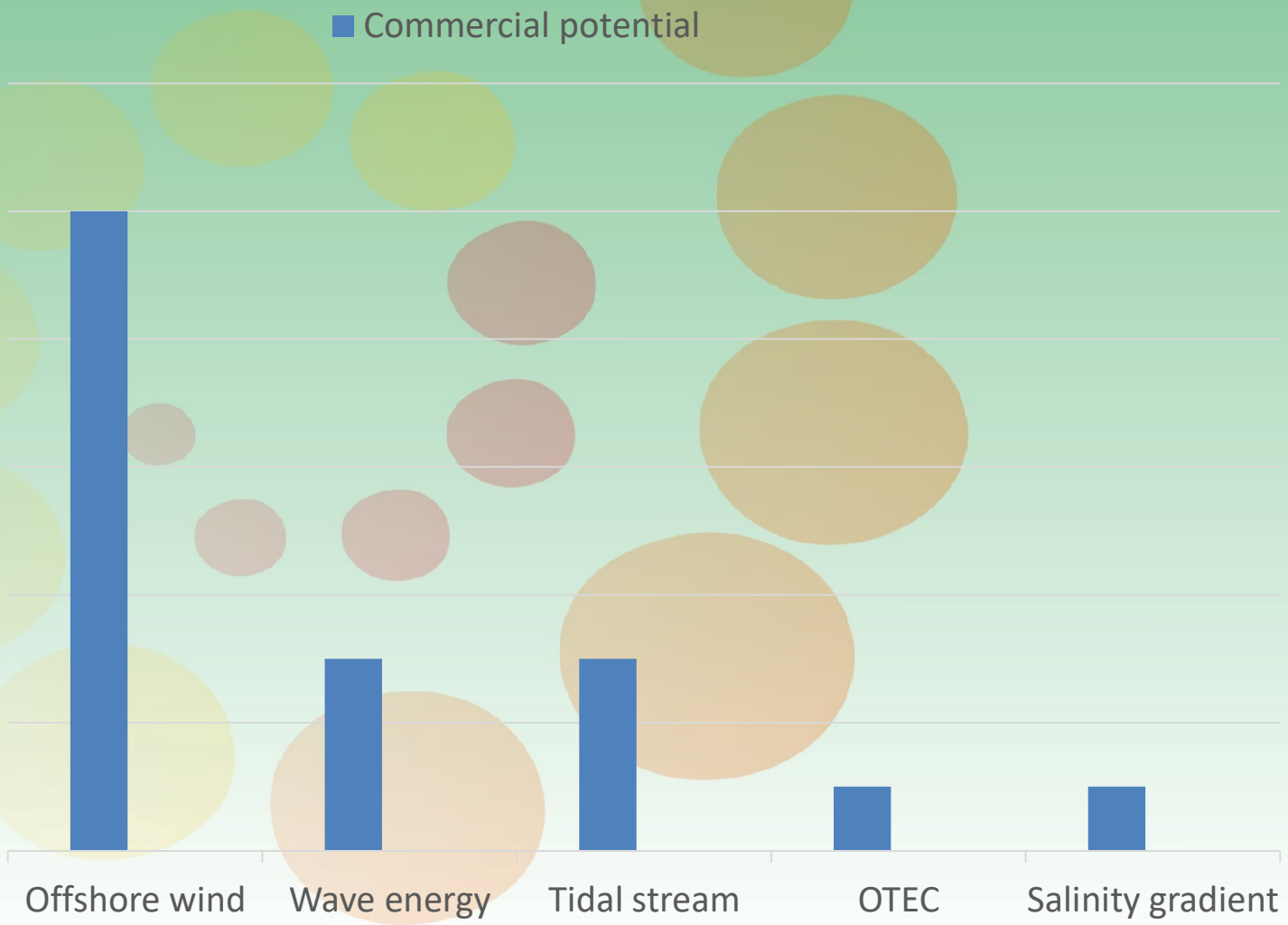


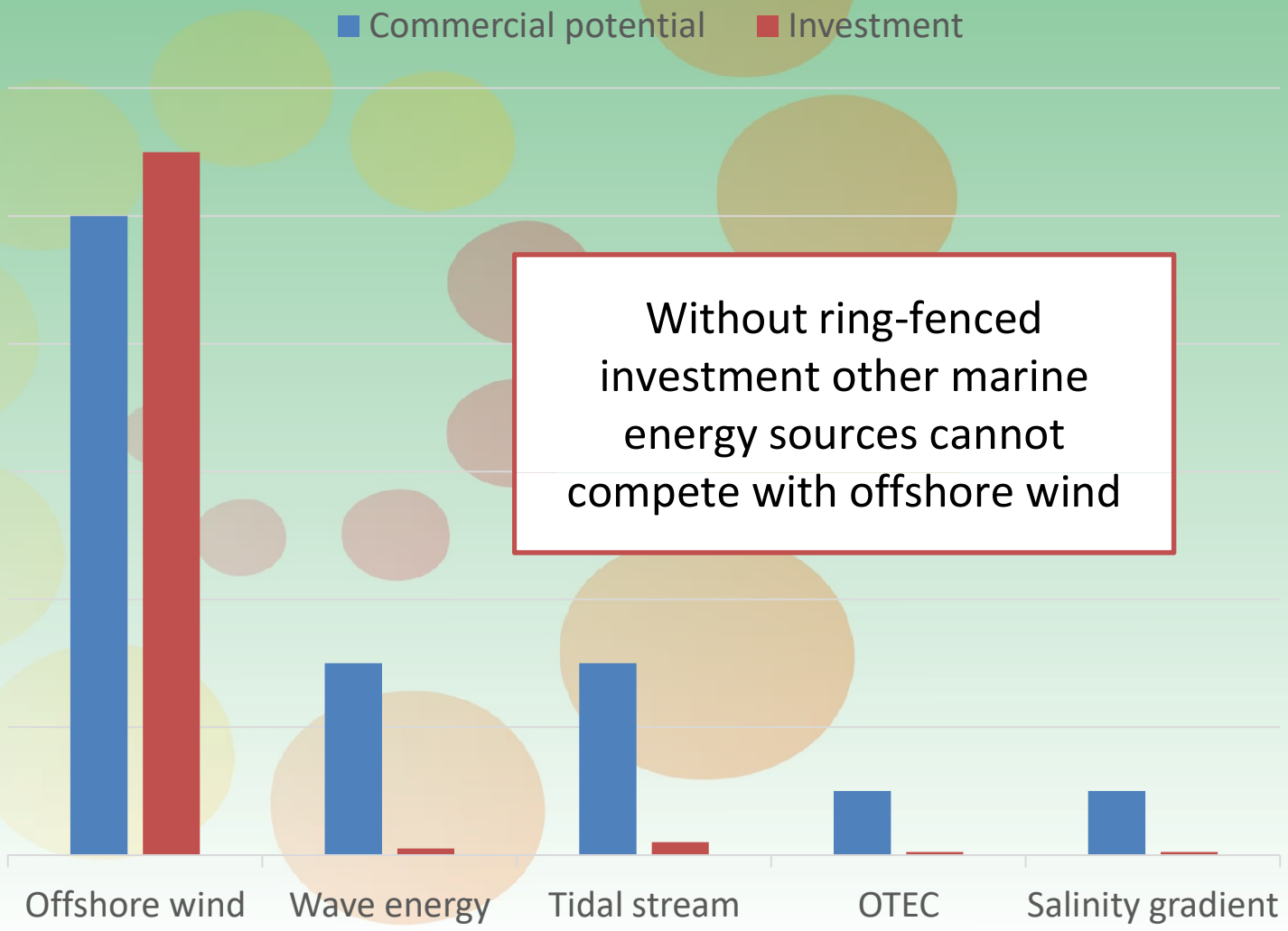
# Status of technologies



# Current commercial potential



# Current investment

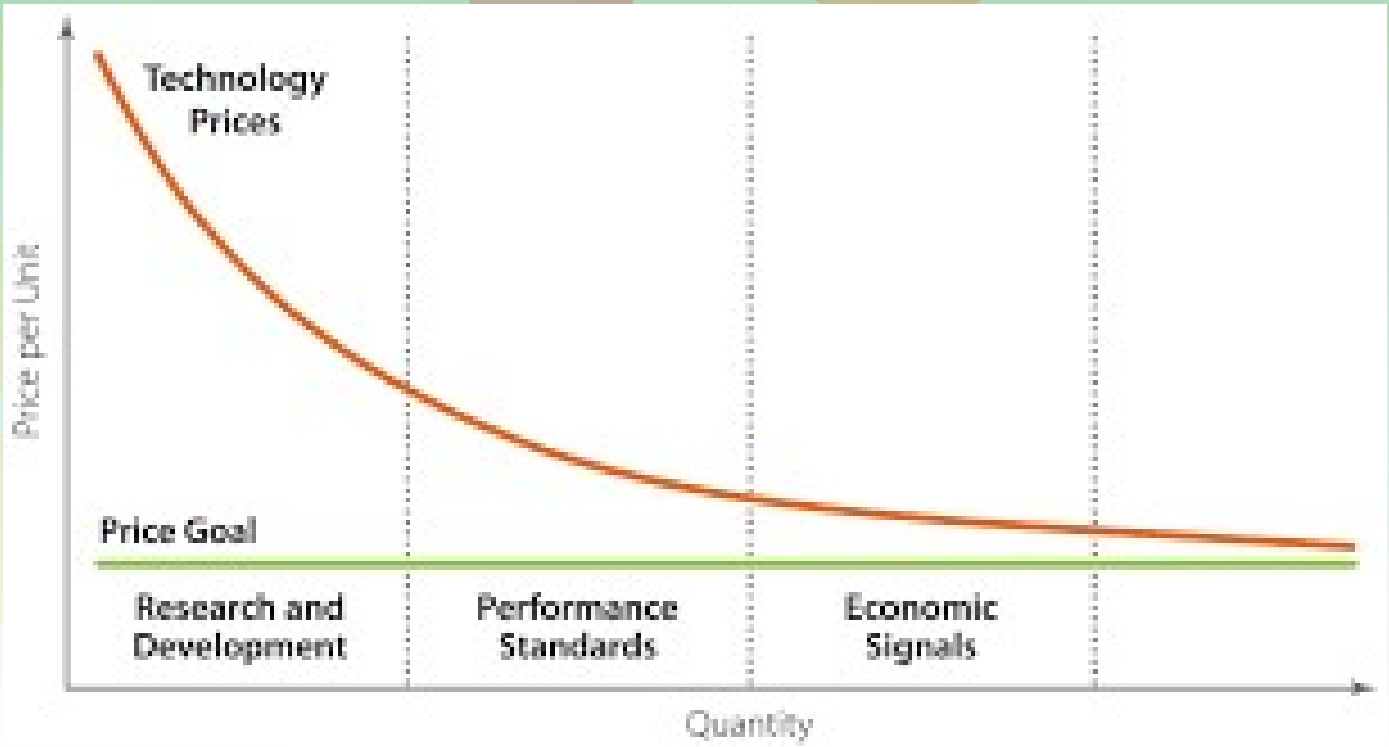



Without ring-fenced investment other marine energy sources cannot compete with offshore wind

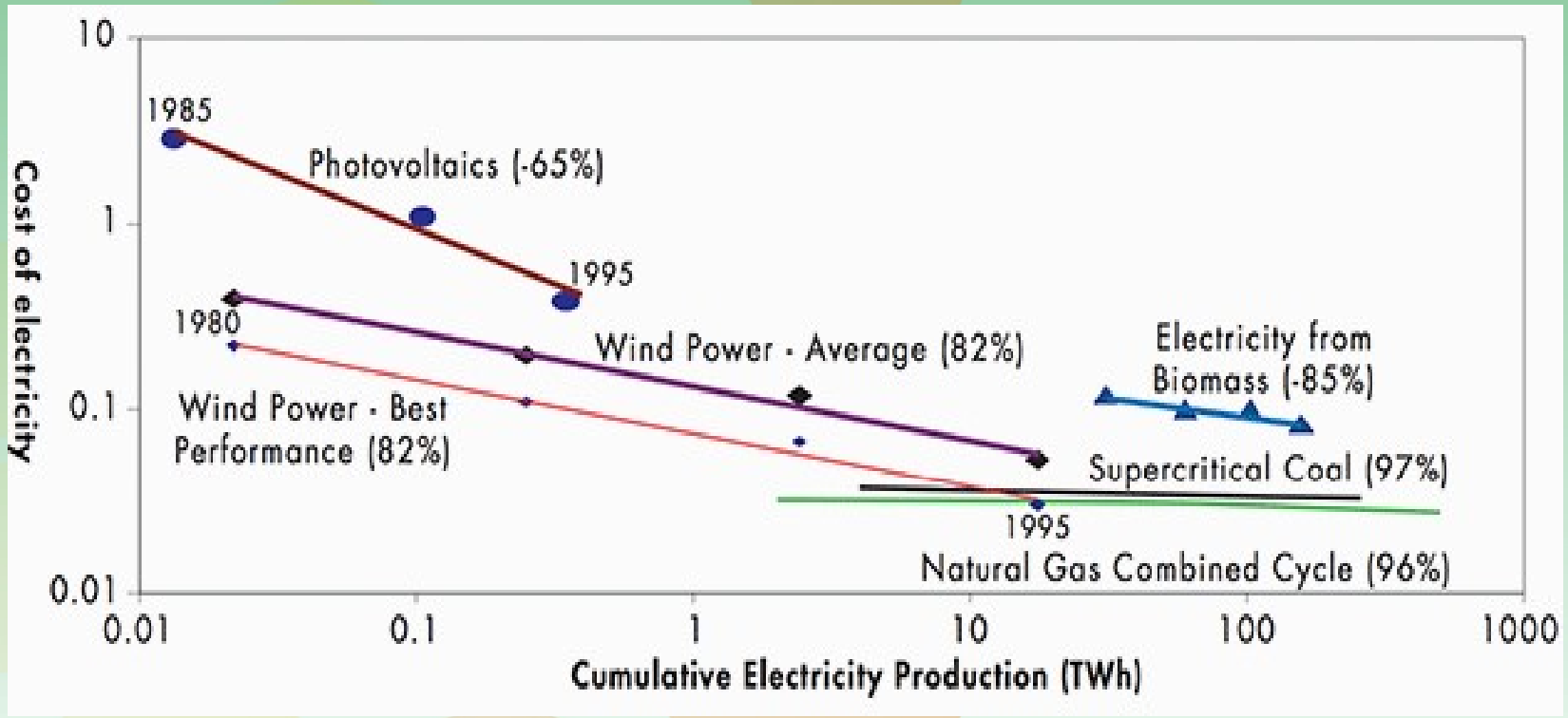
# Future commercial potential

## The learning curve

As more units are built the cost per unit reduces due to technological advances, supply chain improvements, mass production, skills improvements



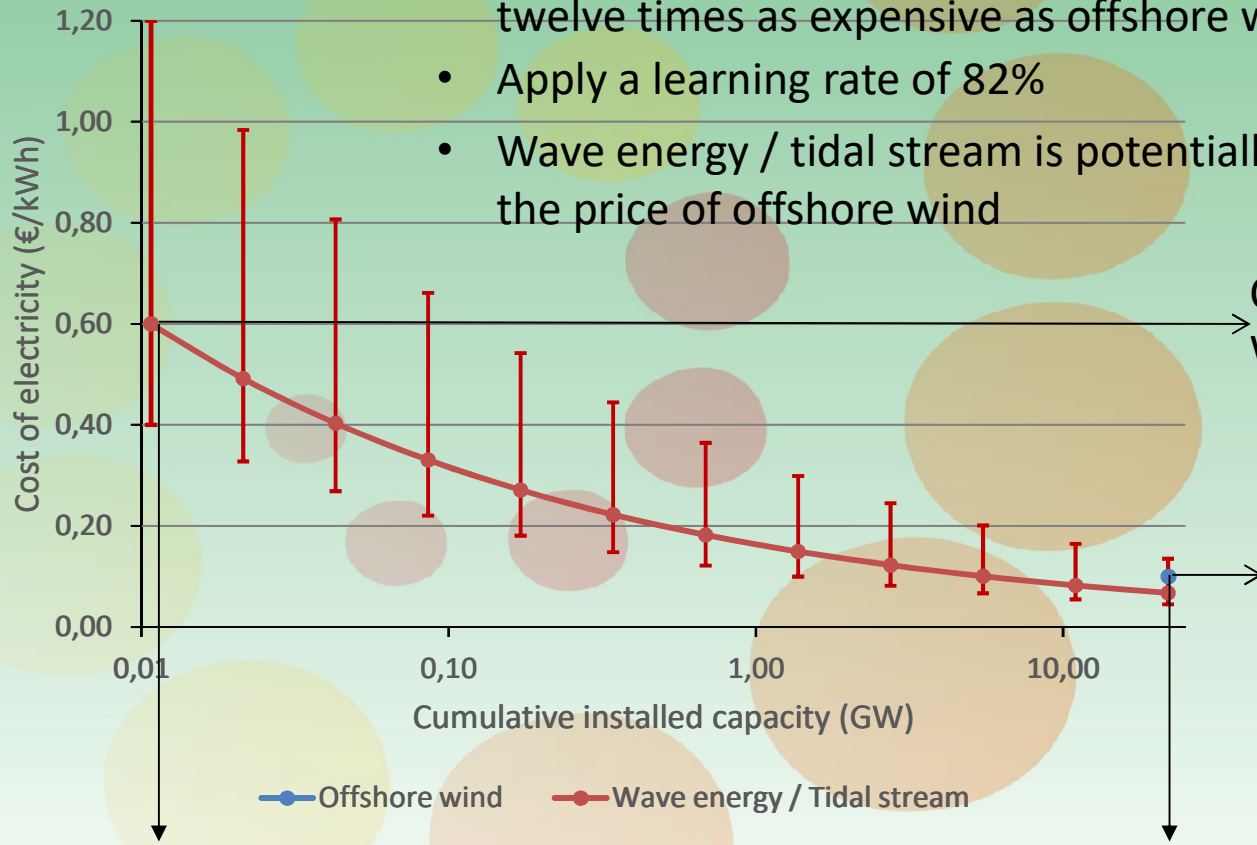
# Typical learning curves




Fastest learning rates typically associated with newest technologies

# Future cost of energy?

- Wave energy / tidal stream is currently four to twelve times as expensive as offshore wind
- Apply a learning rate of 82%
- Wave energy / tidal stream is potentially half the price of offshore wind




Current cost ~ 0.6 €/kWh
Wave energy/Tidal stream

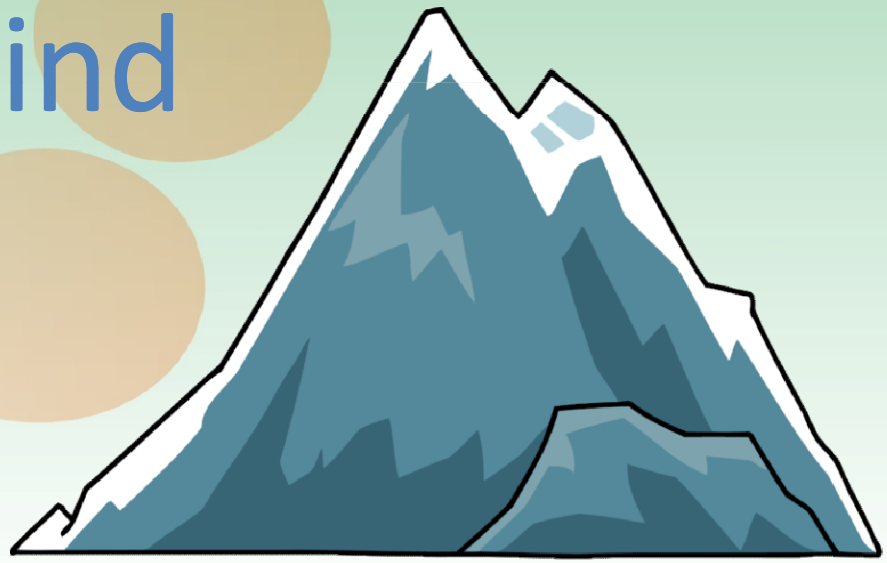
Current cost ~ 0.1 €/kWh
Offshore wind

Current installed capacity
Wave energy / Tidal stream (<10 MW)

Current installed capacity
Offshore wind (22 GW)

# Key challenge

How to provide support to enable marine energies other than offshore wind to develop



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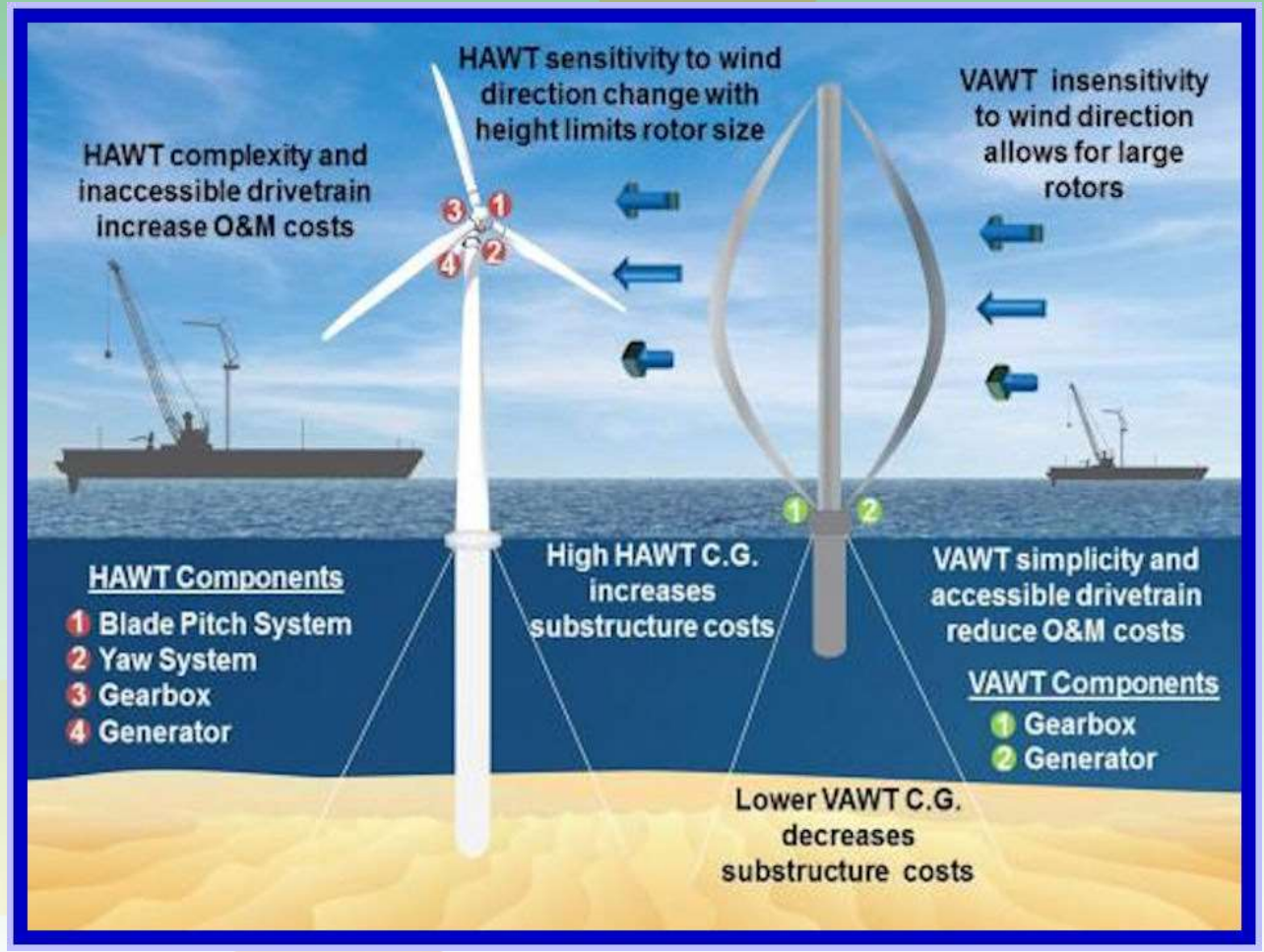
# Offshore wind: technological lock-in



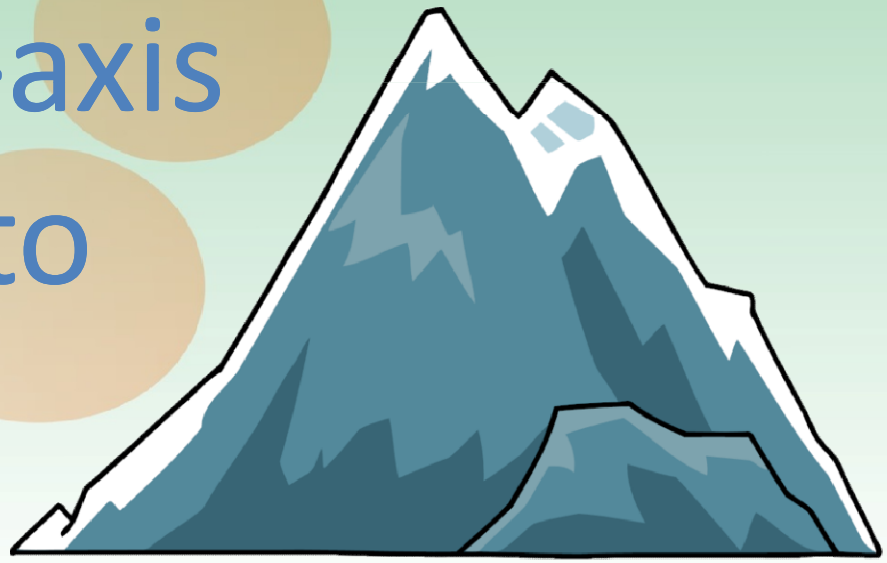
# Offshore wind: technological lock-in

## POTENTIAL IMPACT

**Offshore wind is more expensive in the long-term because horizontal-axis turbines are the cheapest solution in the short-term**

# Key challenge

How to provide support to enable marine energies other than horizontal-axis Wind turbines to develop



# Wave energy: lack of convergence

# Diversity is core to our work in early stages

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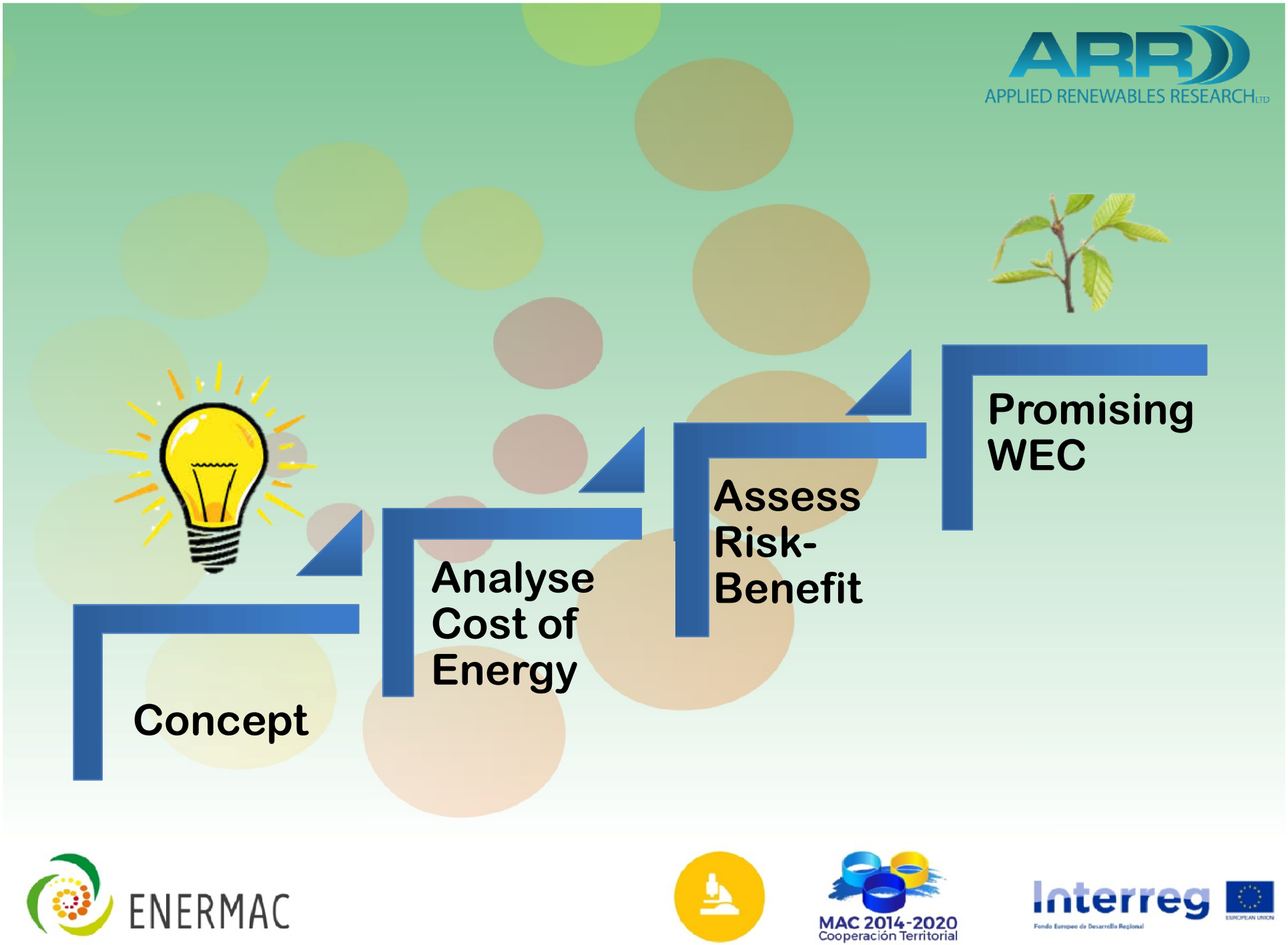
ARR
APPLIED RENEWABLES RESEARCH LTD
Promising WEC
Assess Risk-Benefit
Analyse Cost of Energy
Concept
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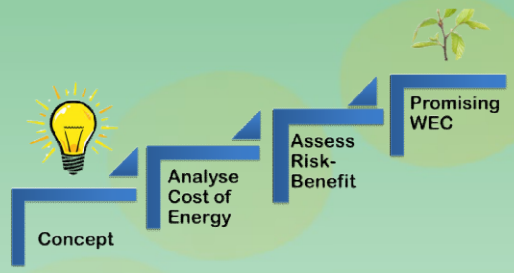
# Challenges in wave energy




Difficult to calculate

Simpler heuristics

Concept Cost of Energy

Concept Hydrodynamics

Known WEC Hydrodynamics

Concept Techno-economics

Parametric measures

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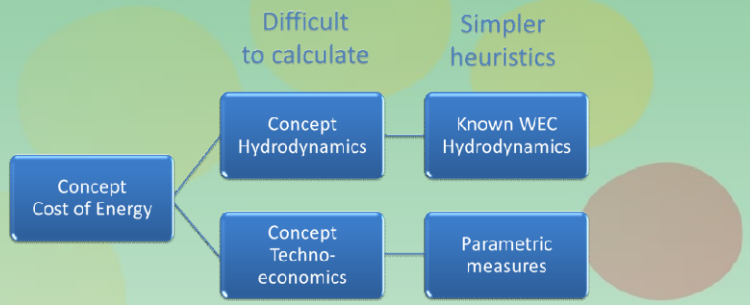
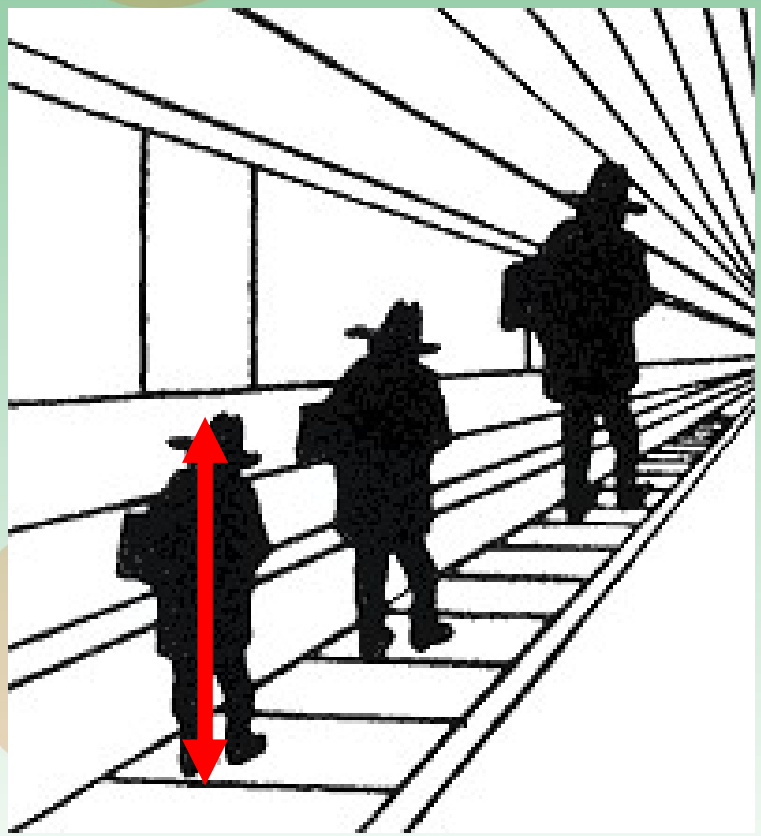
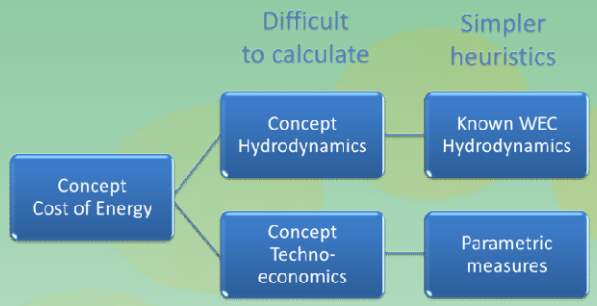
# Problems with heuristics

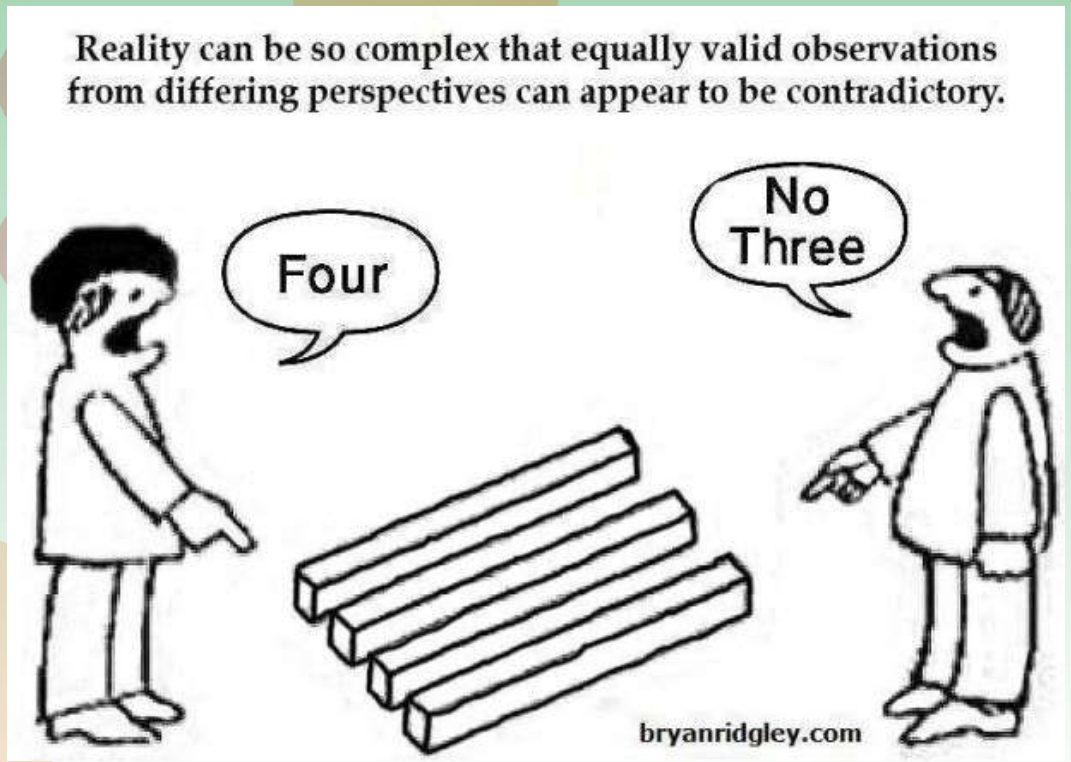


Ref:
Daniel Kahneman (2011)
Thinking: fast and slow

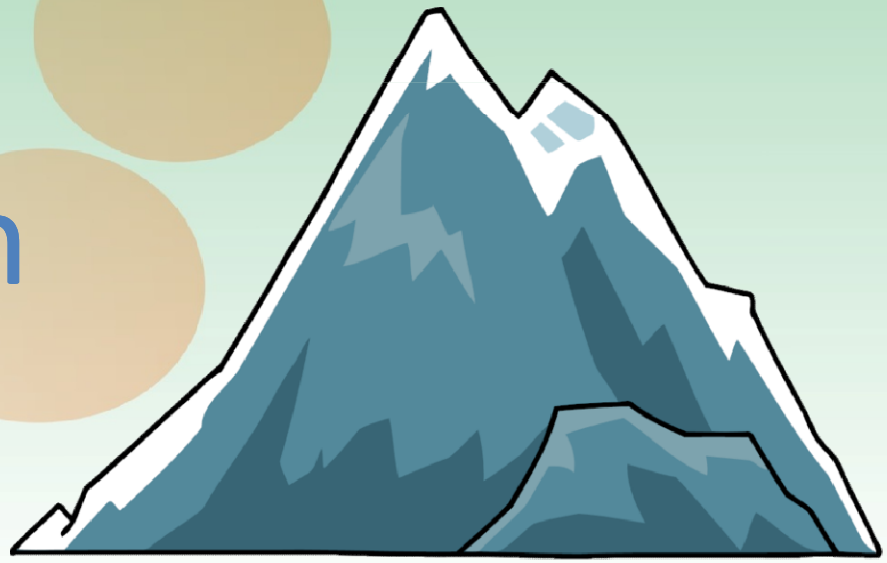
# Problems with heuristics



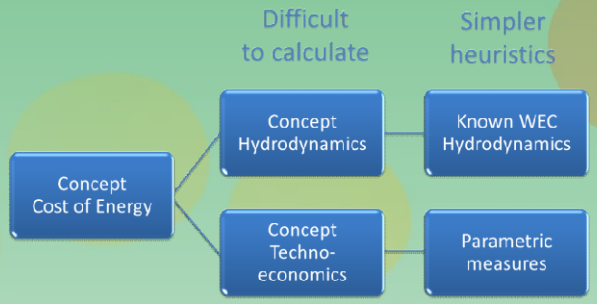



# Key challenge

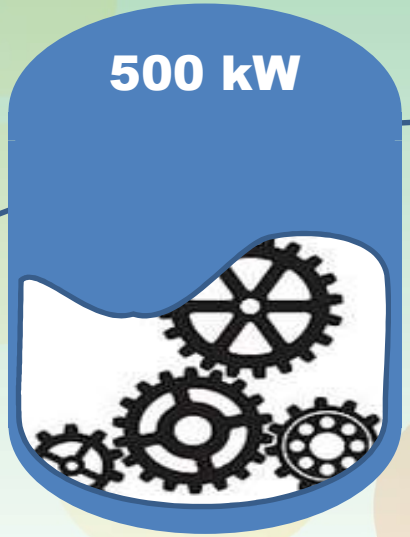
To develop models of wave energy that do not distort the search for the optimal solution



# Parametric measure – power / volume

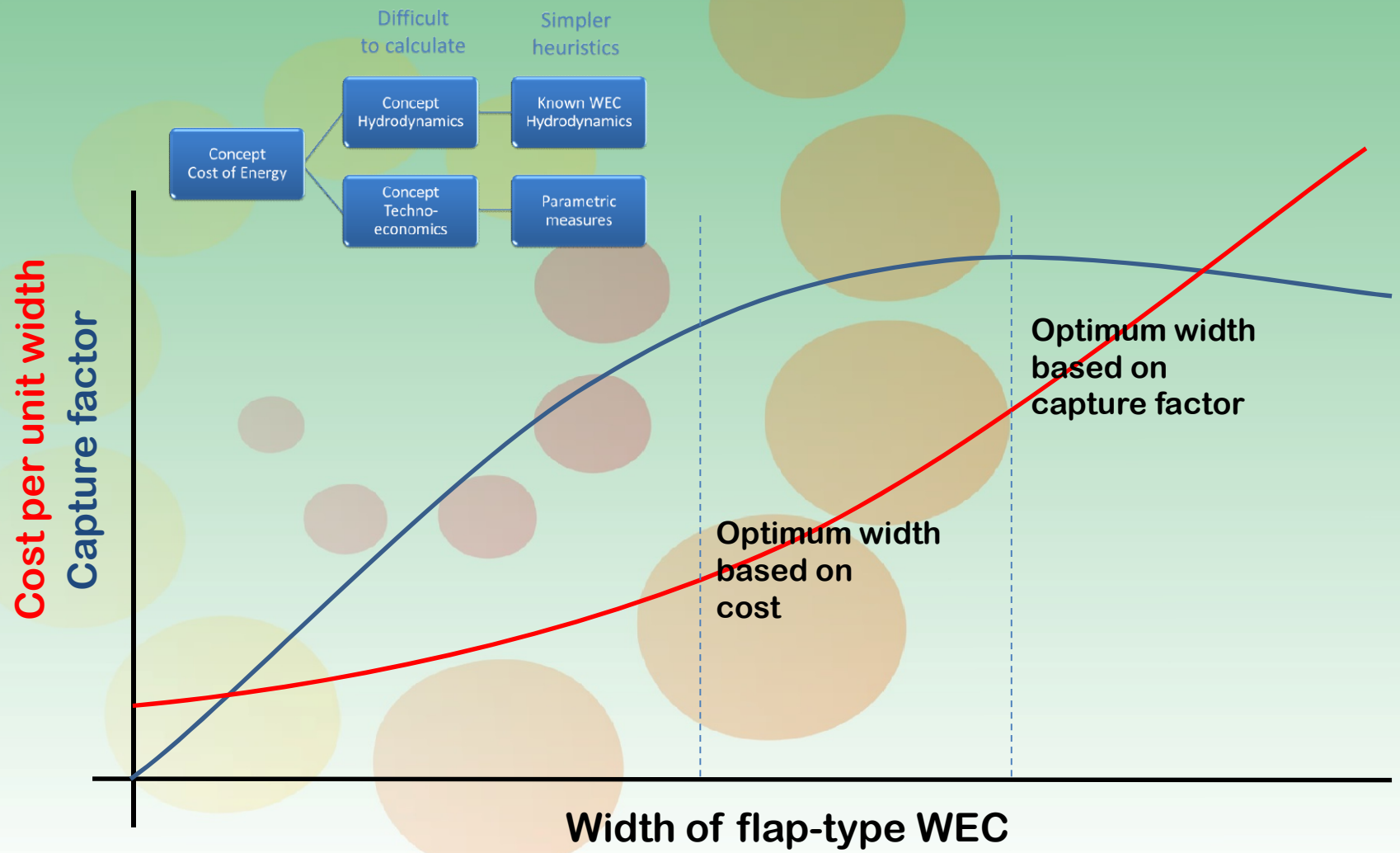



Cheap ?




Expensive ?

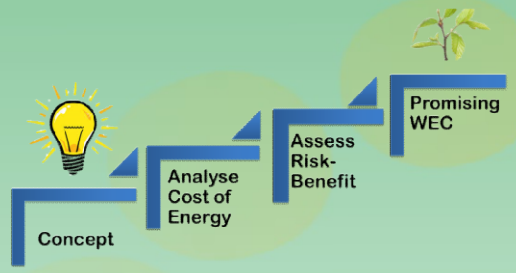
# Parametric measure – capture factor

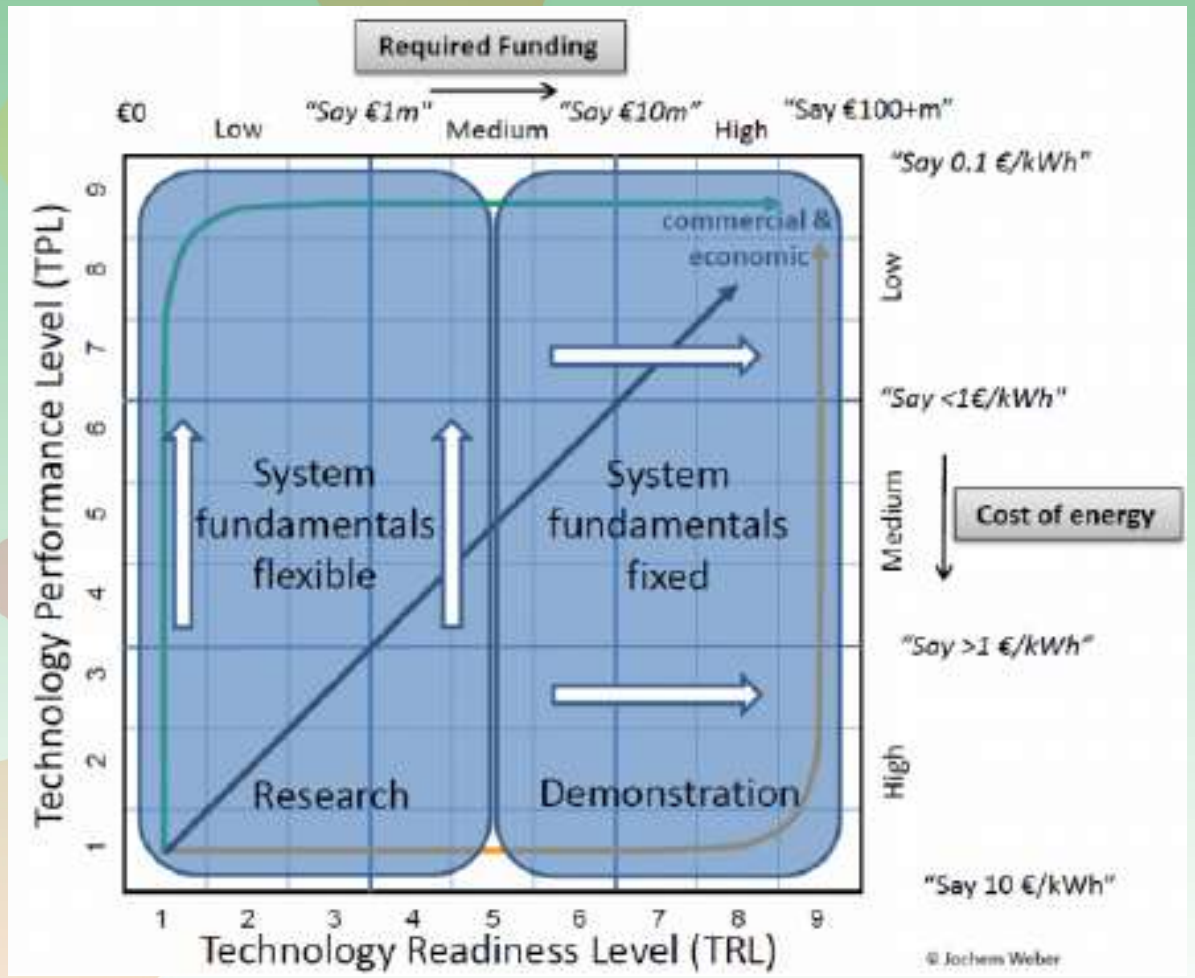


# Key challenge

To develop parametric measures that reflect the underlying potential of a concept

# Minimising risk-benefit ratio

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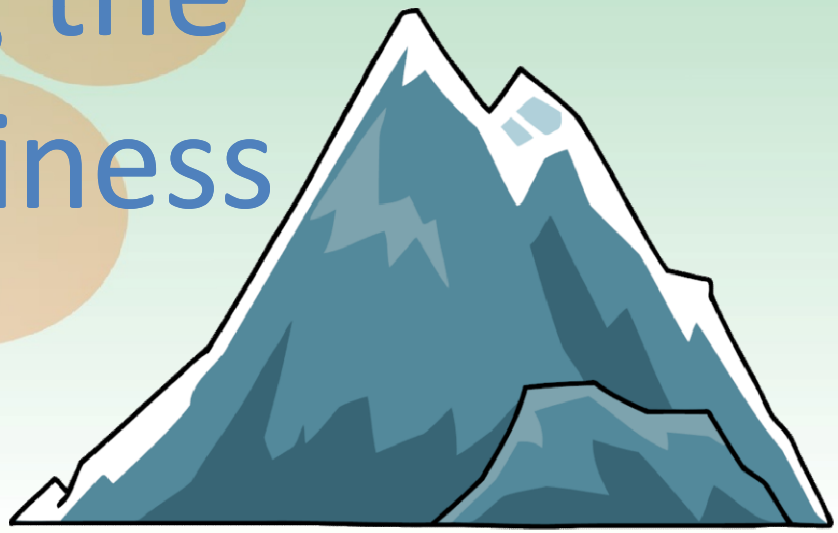
# Key challenge

To increase the Technology Performance Level (TPL) before increasing the Technology Readiness Level (TRL)



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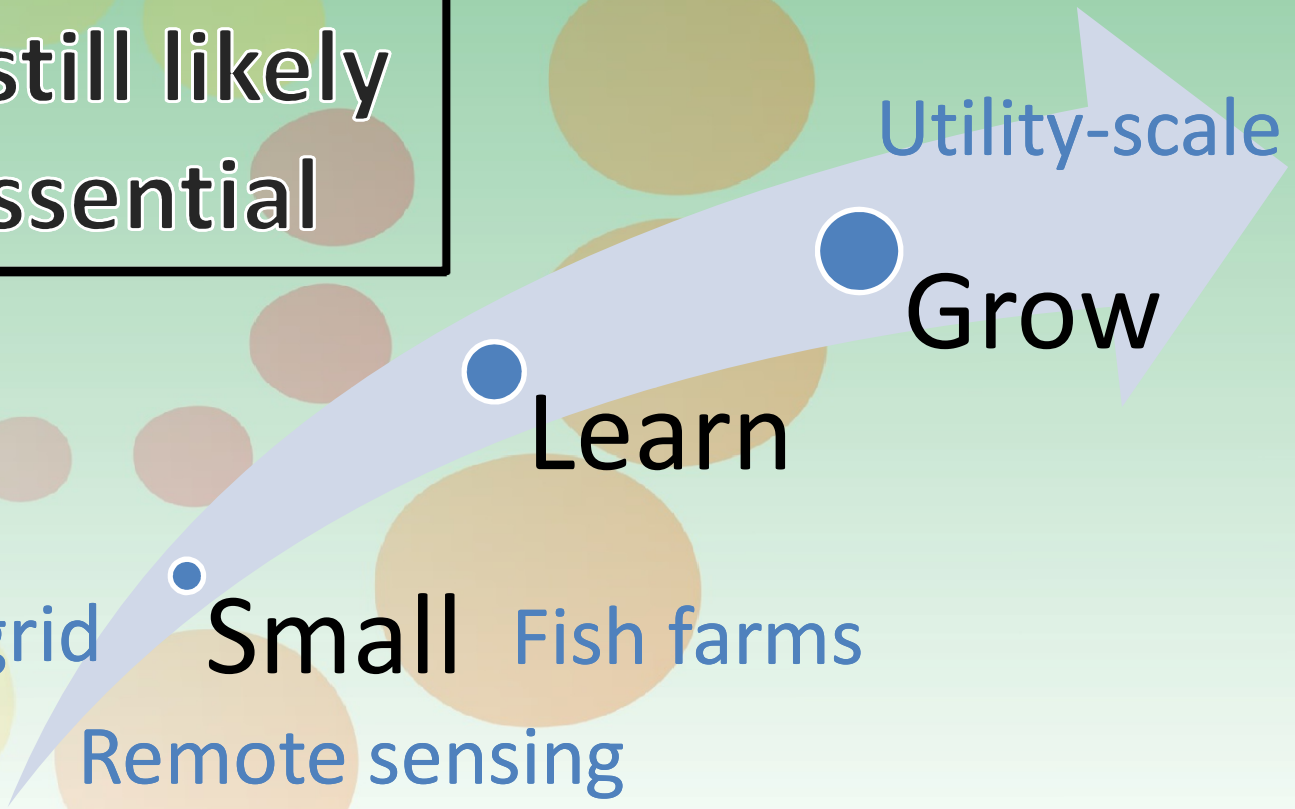
# Start small with high value

**Government support still likely to be essential**



# Gracias

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