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Offshore Wind

Ing. Lourdes Guiñazu

Agenda

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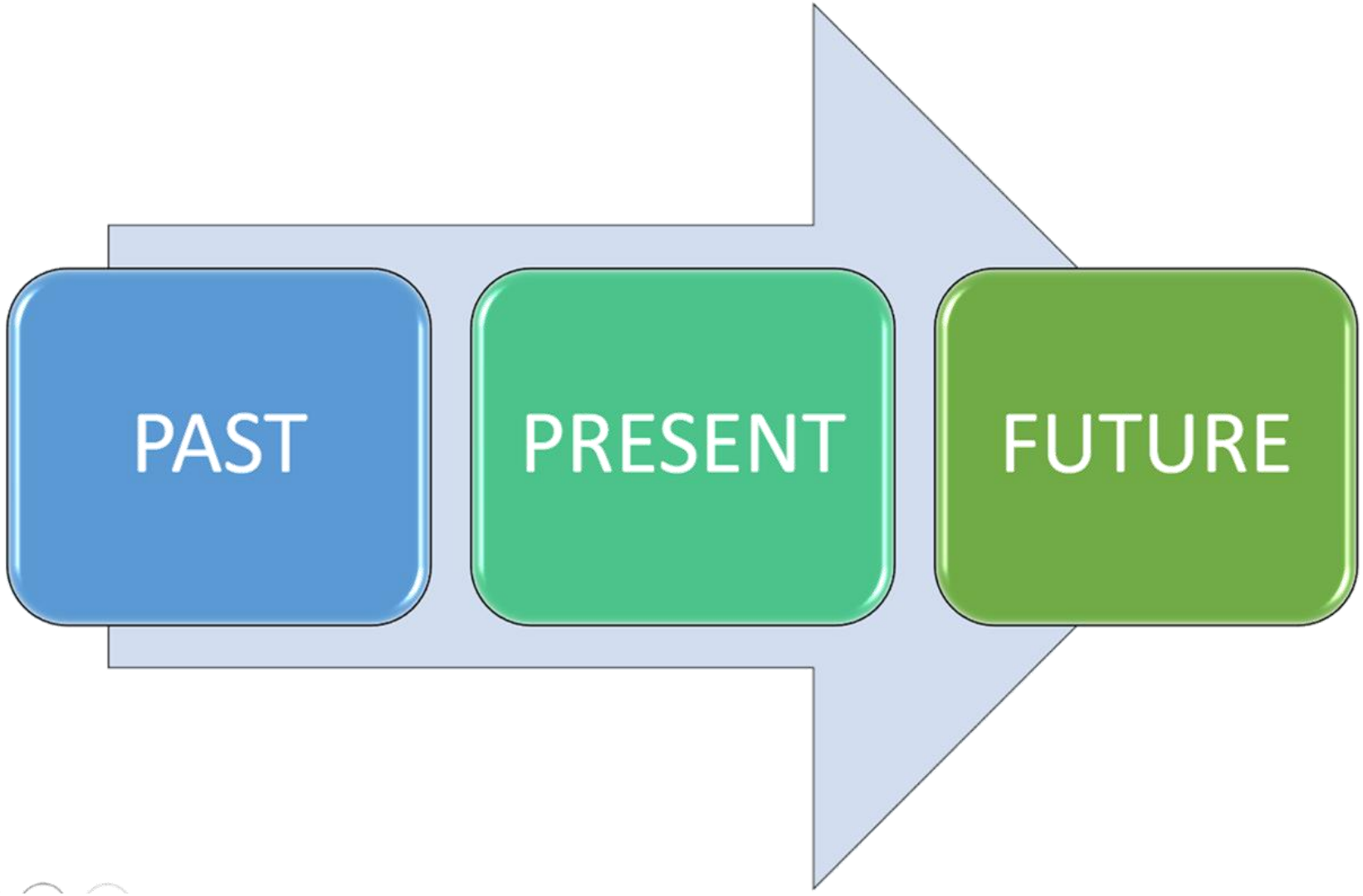
- Energy transition and Climate Change
- Why Offshore Wind
- Platforms
- Offshore Wind Challenges
- Summary

Offshore History



Offshore History

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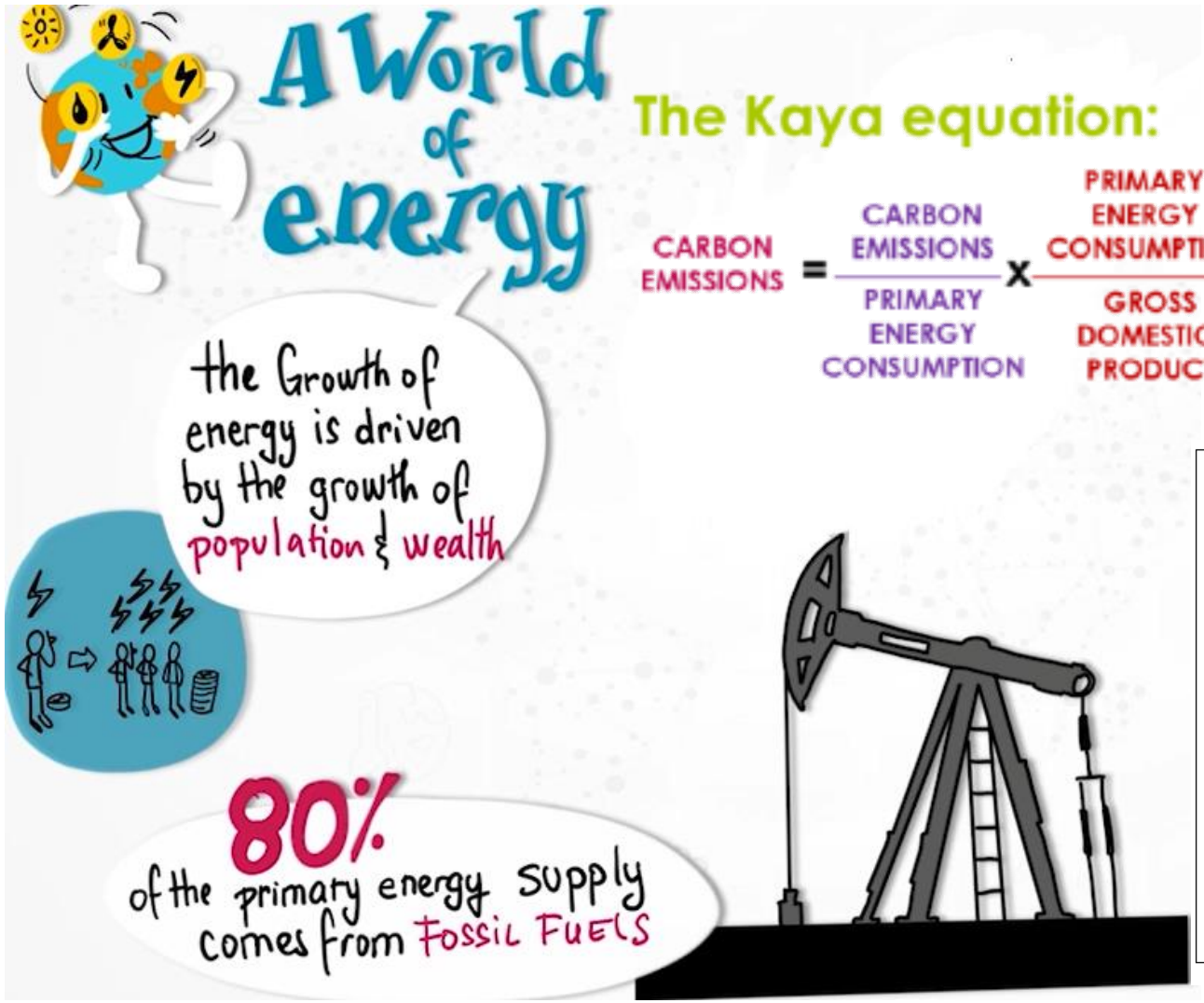
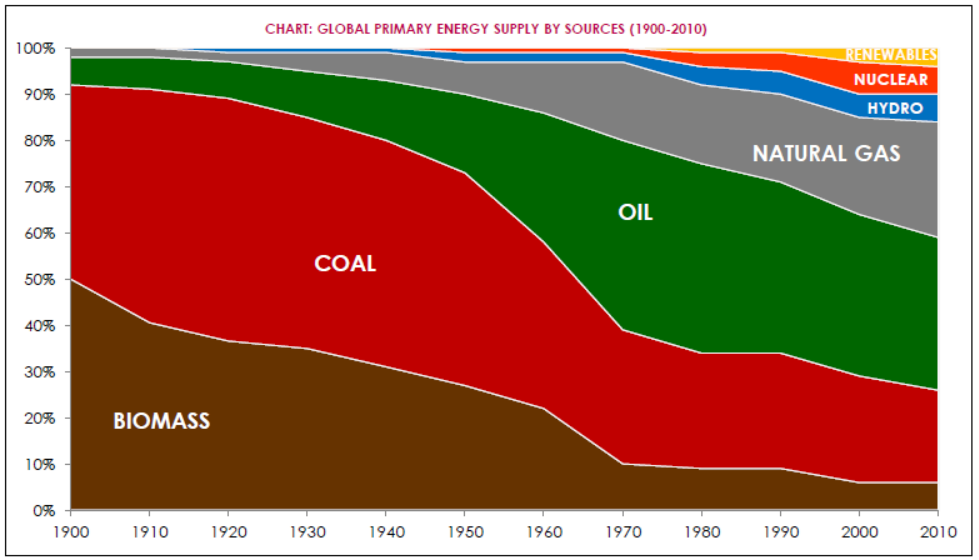
PRESENT

Climate Change



The Kaya equation:

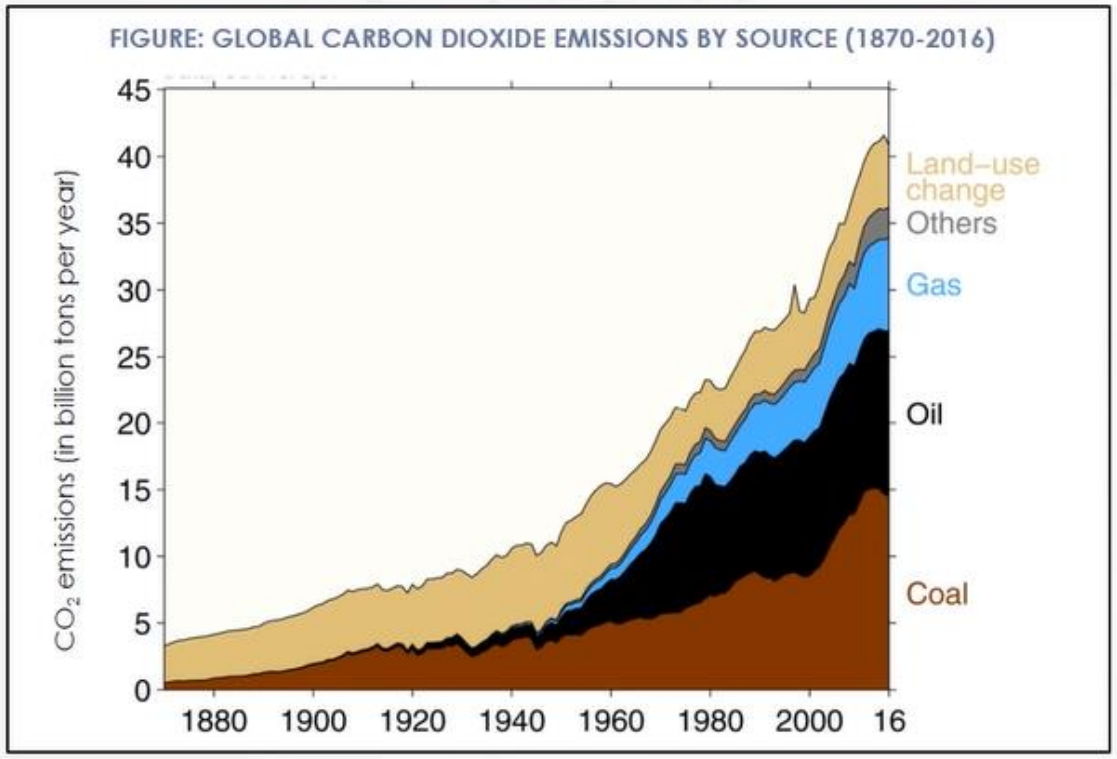
$$\text{CARBON EMISSIONS} = \frac{\text{CARBON EMISSIONS}}{\text{PRIMARY ENERGY CONSUMPTION}} \times \frac{\text{PRIMARY ENERGY CONSUMPTION}}{\text{GROSS DOMESTIC PRODUCT}} \times \frac{\text{GROSS DOMESTIC PRODUCT}}{\text{TOTAL POPULATION}} \times \text{TOTAL POPULATION}$$



Source: Vaclav Smil (2010), Energy Transitions; BP Statistical review of world energy 2018

Climate Change

Fossil fuel combustion account today for more than **80% of CO_2 emissions**, which represent 3/4 of total greenhouse gases emissions.



Source: Global Carbon Project (2017)

CAUSAS Y CONSECUENCIAS

Gases de Efecto Invernadero (GEI): CO2, CH4, N2O, HFCs, PFCs, SF6

- Principales actividades humanas:
- Quema de combus-bles fósiles
- Deforestación
- Tratamientos de residuos

Impactos negativos:

- Sequías - Inundaciones
- Variaciones en los sistemas climá-cos
- Pérdida de recursos naturales y biodiversidad
- Aumento del nivel del mar

Climate Change

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Towards a net-zero emissions world

OBJECTIVE

to hold "the increase in the global average temperature to well

below 2°C

above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C [...]"

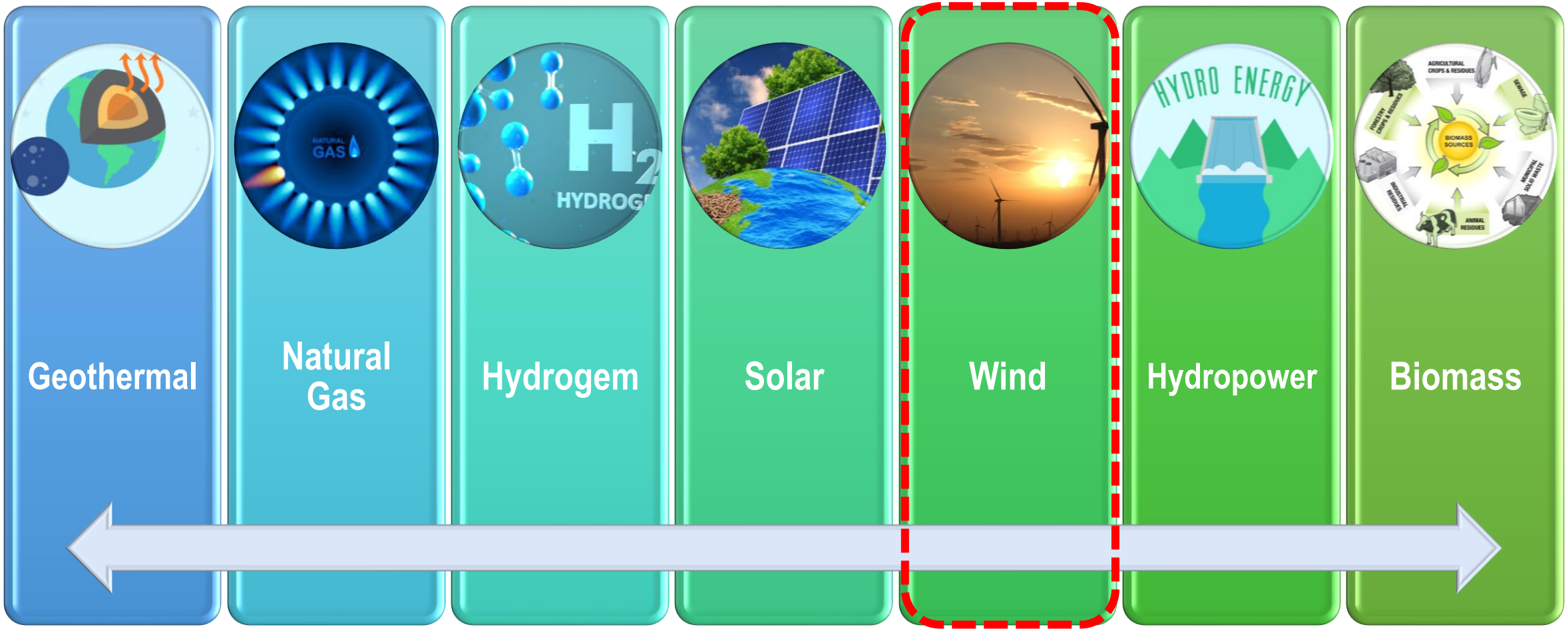
Towards a net-zero emissions world

IMPLICATIONS

No **net-positive greenhouse gases emissions** in the second half of the 21st century.

PHOTOGRAPH: ADOPTION OF THE PARIS AGREEMENT (DEC. 2015)

Low Carbon Energy Sources



Offshore Wind Power

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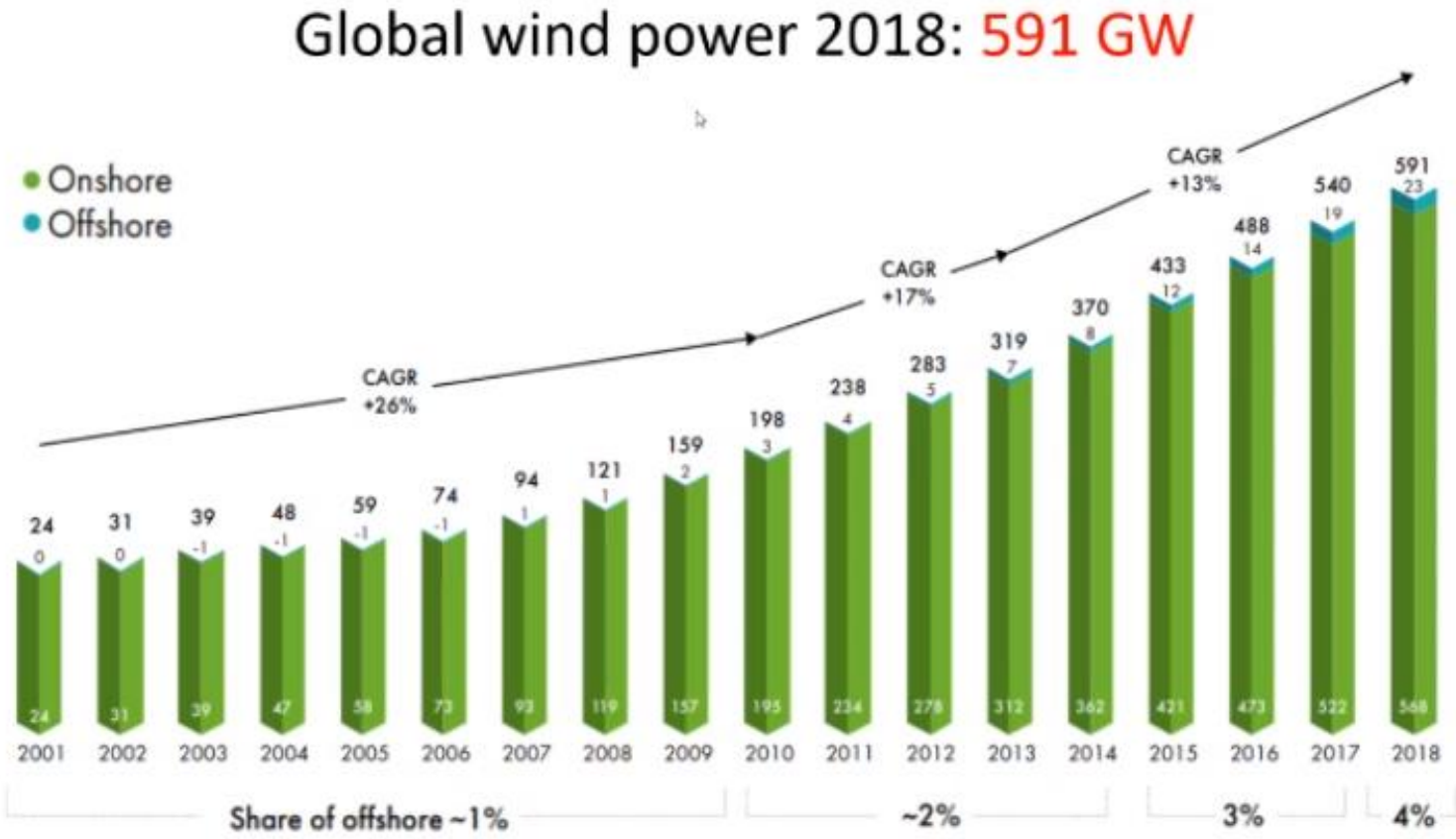
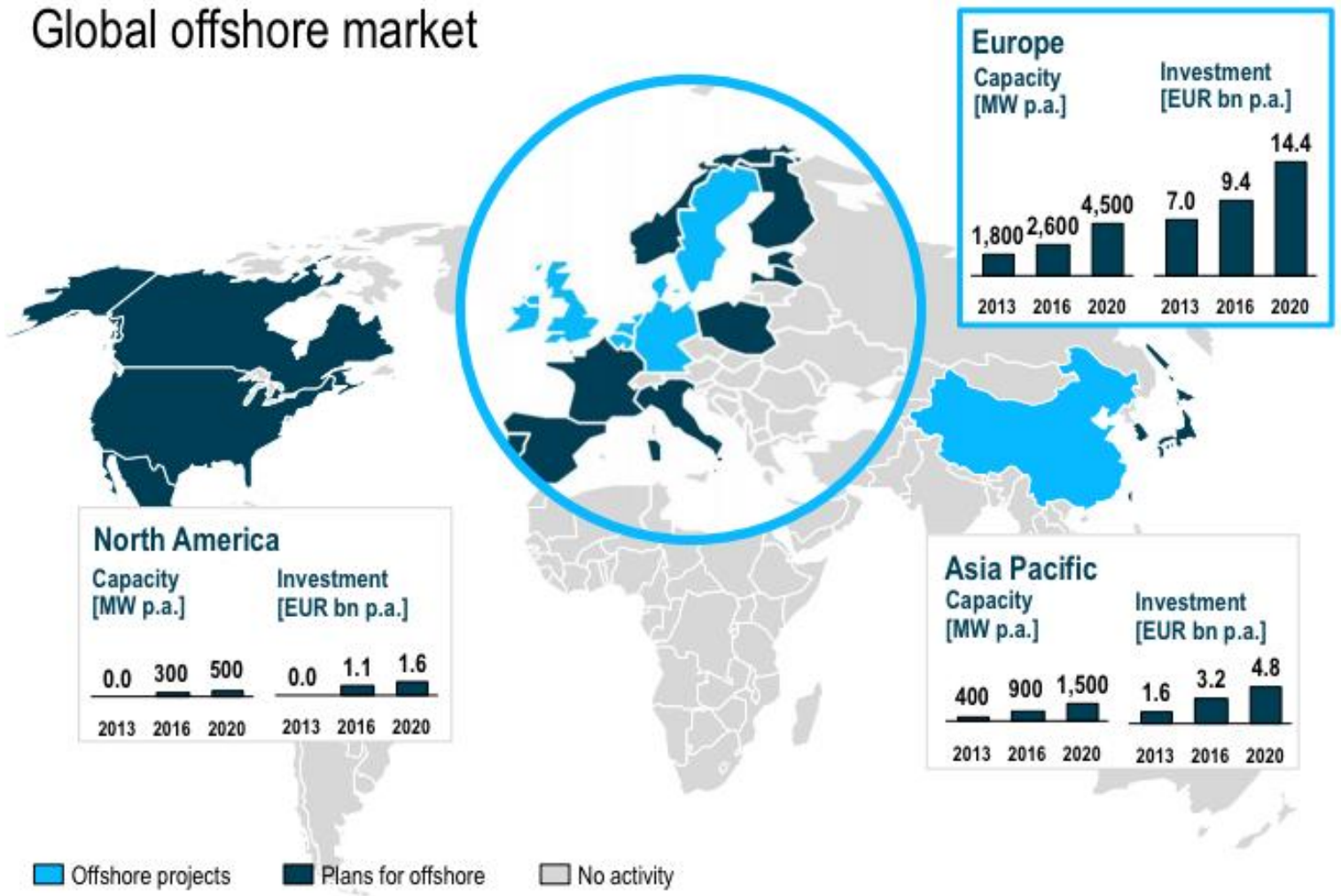
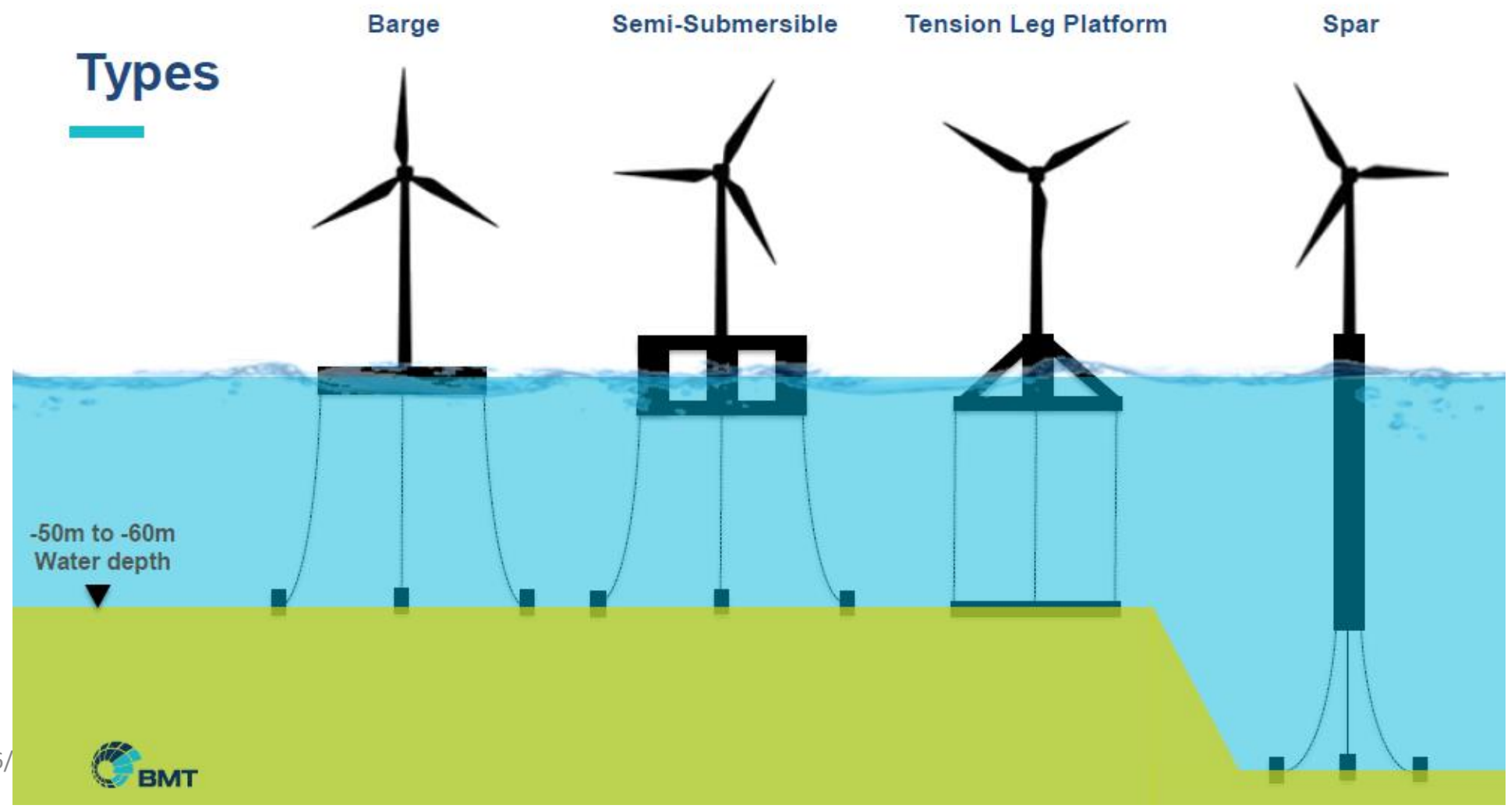
Why Offshore Wind?



Offshore Market



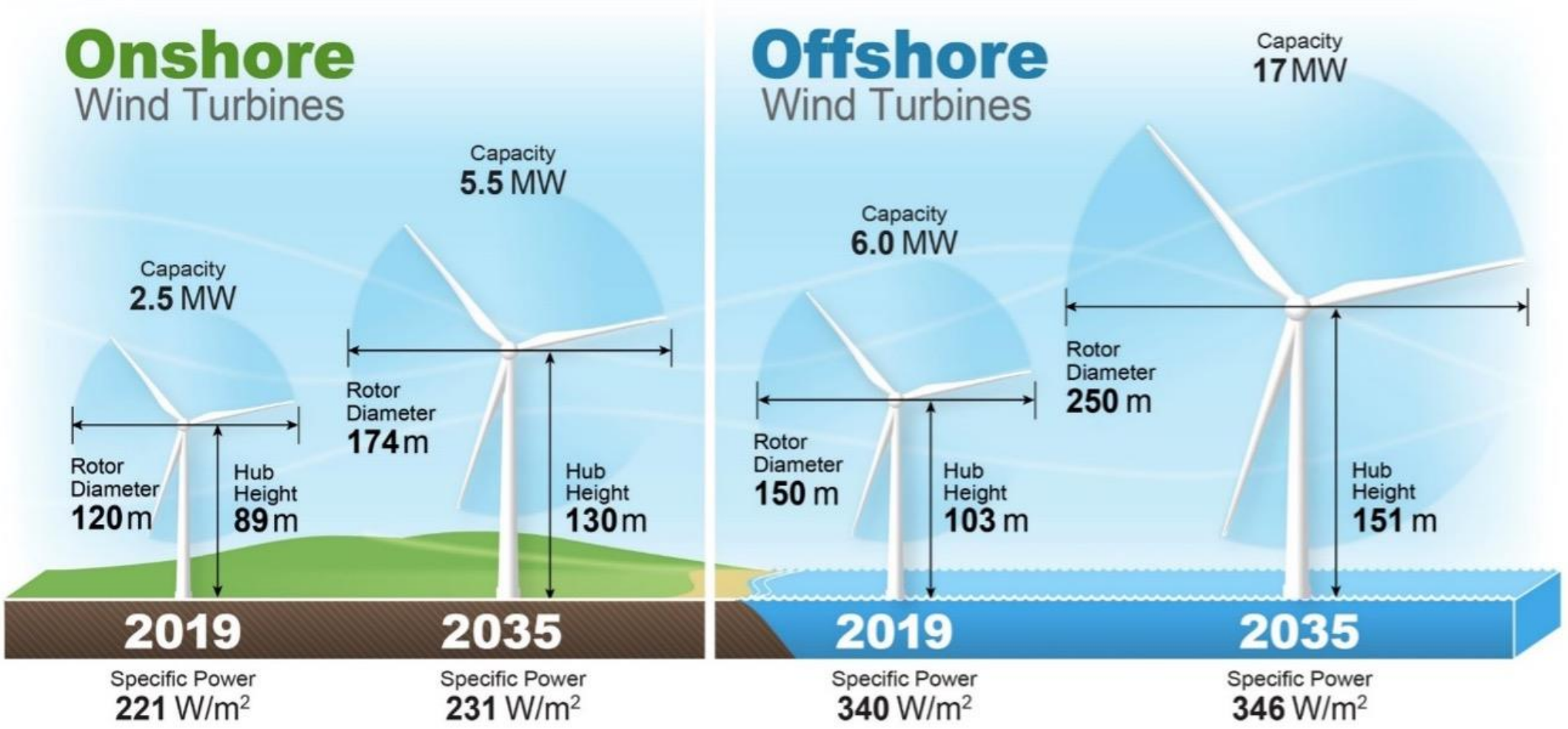
Offshore Wind platforms



Why Offshore

- Wind is more regular
- Wind is stroger
- Biger rotors
- More Energy/m2
- Enviromental (noise and visual polution)

Onshore vs. Offshore

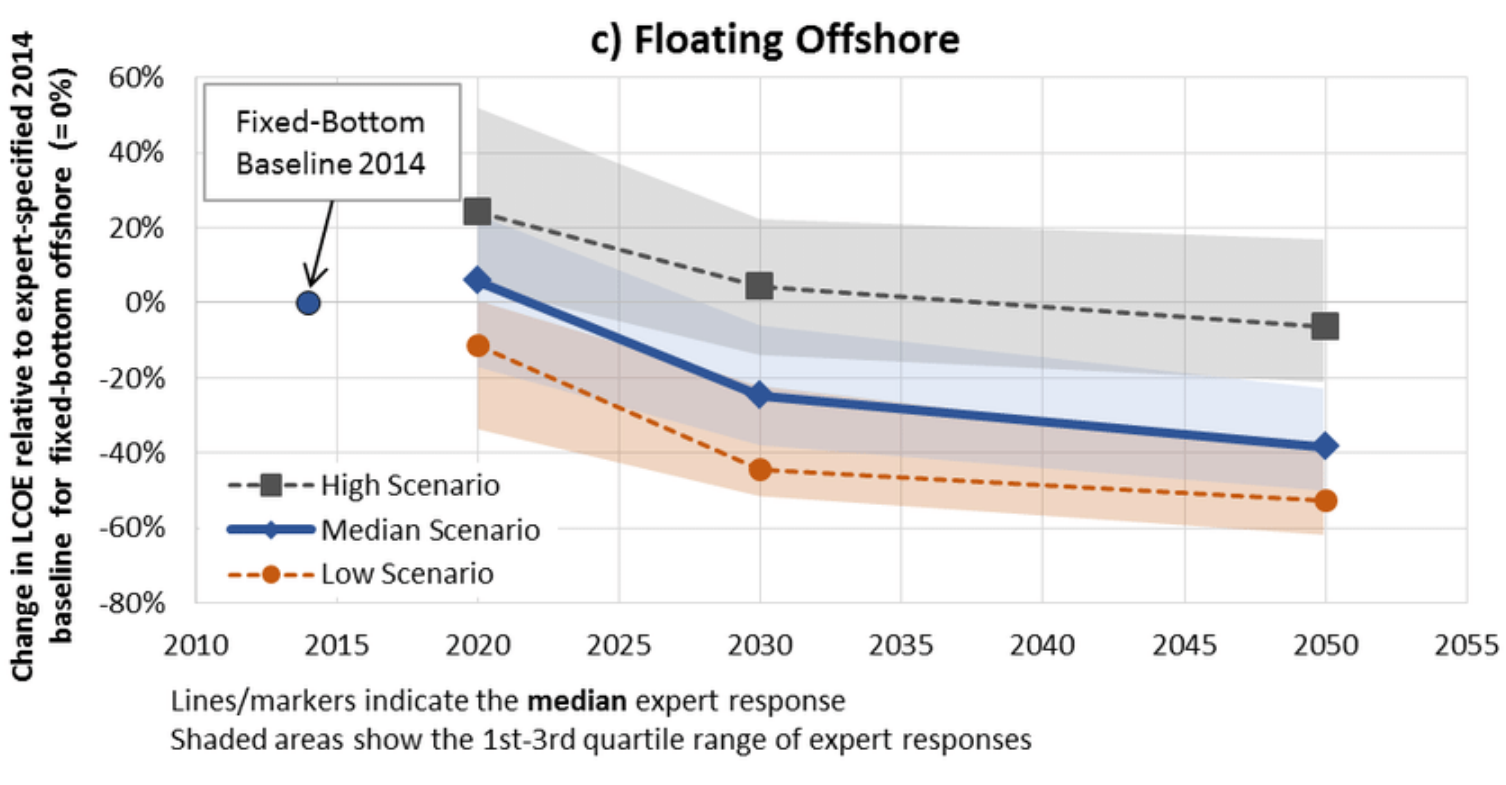


Offshore Wind Challenges

Offshore Wind Challenges

1 Decrease LCOE

LCOE: costo promedio total de construir y operar una central eléctrica y dividirlo entre la energía total a ser generada durante su vida útil.



Offshore Wind Challenges

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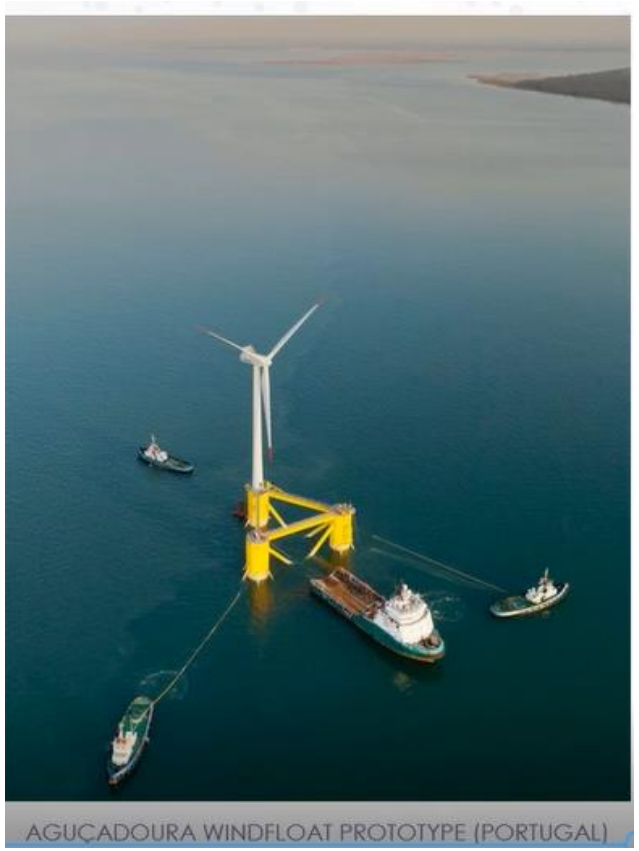
2 Stability While towing

- **Assembly Offshore Wind in the dock**



Offshore Wind Challenges

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3

Stability
Once Installed

- **Keep the blade perpendicular to the wind direction**
- **Innovation**

Ingenious floater design insuring stable wet towing

Innovative movement damping systems for a **better stability in a production phase**

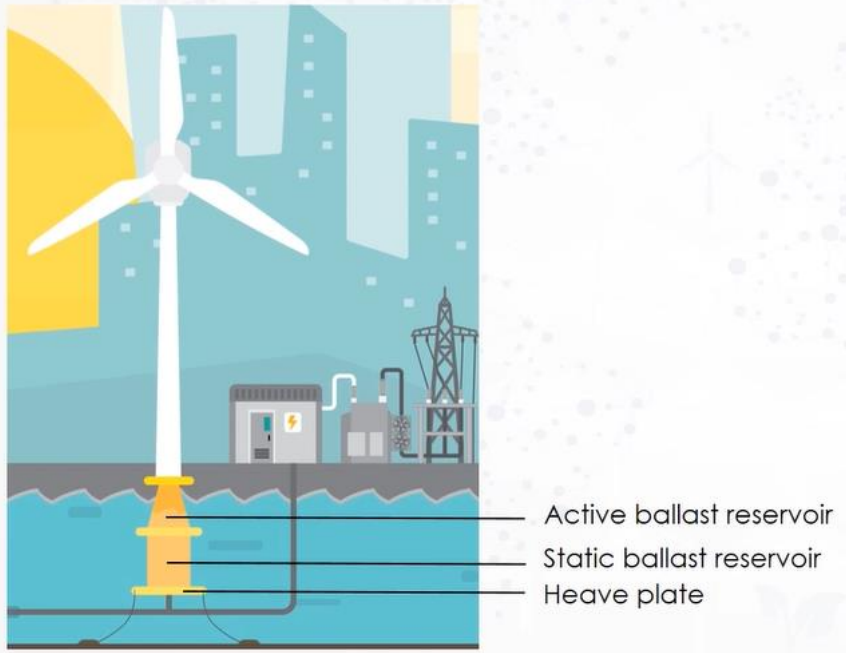
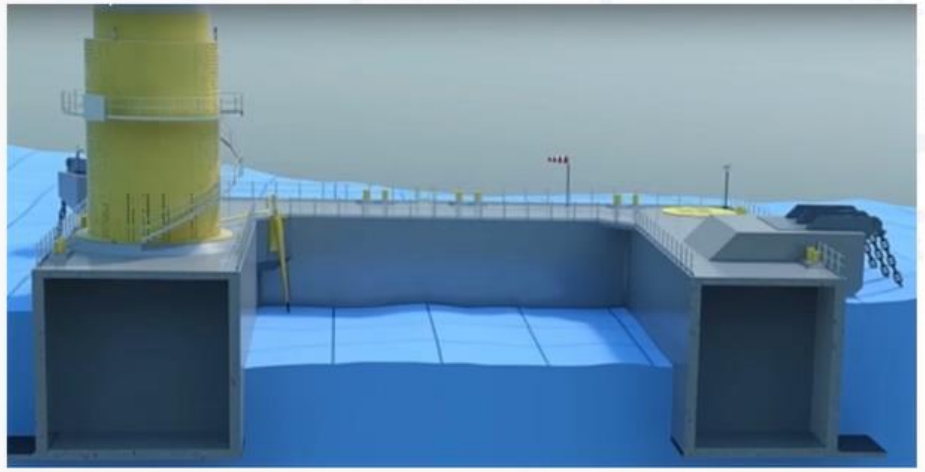


FIGURE: INSIDE A FLOATER USING DAMPING POOL SYSTEM



Offshore Wind Challenges

4 Minimize Fatigue

5 Maximizar Production

Control in production

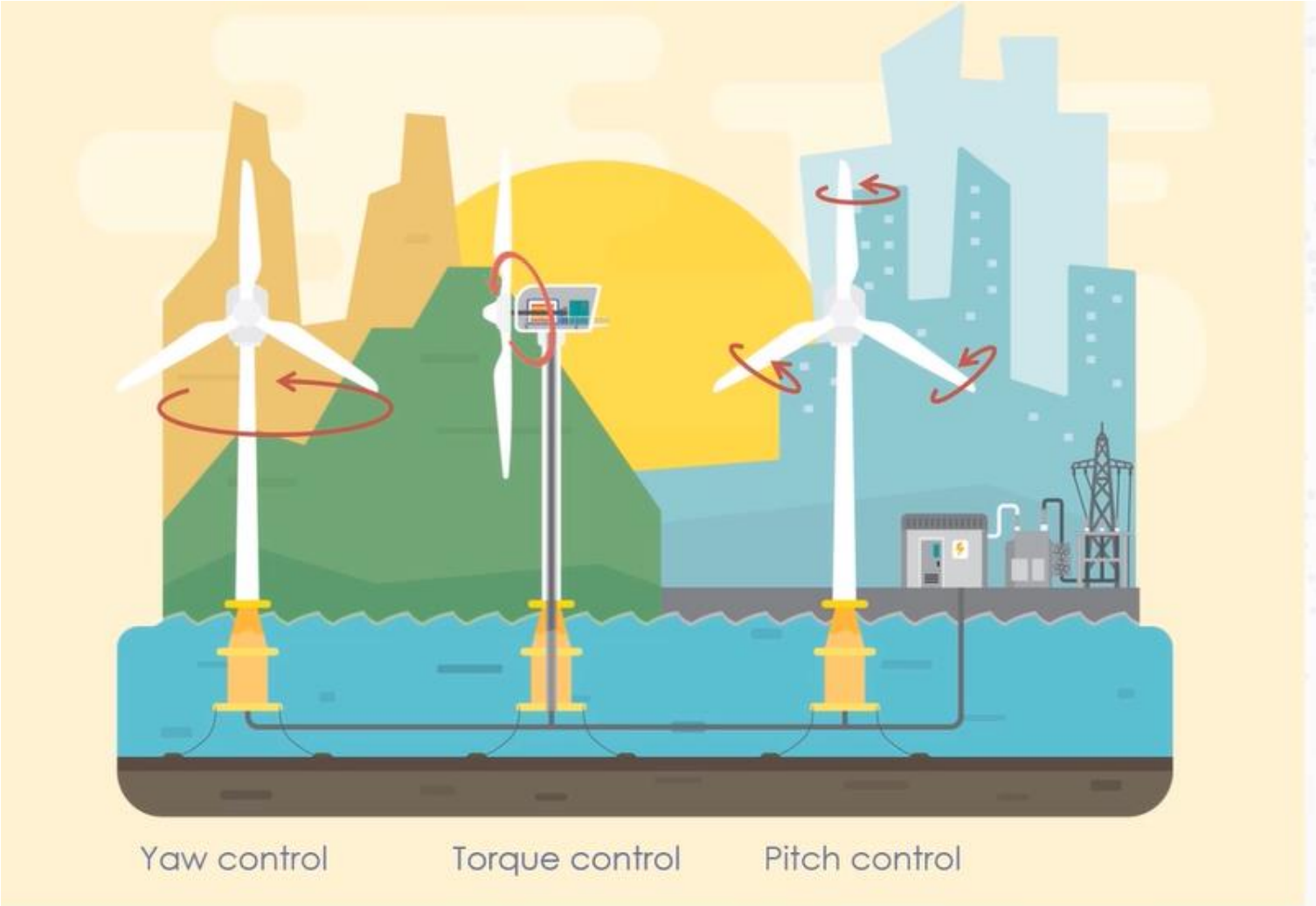
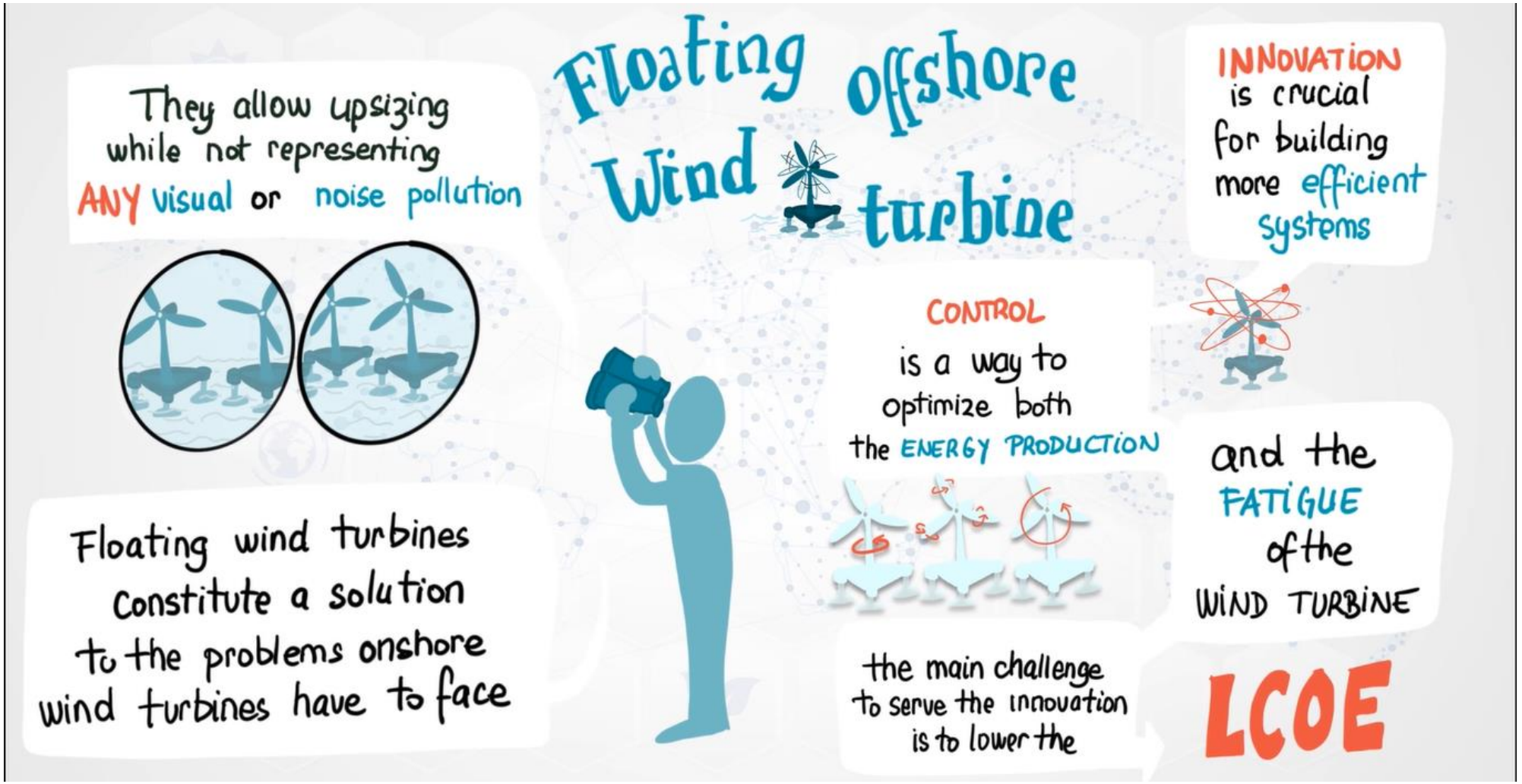


FIGURE: CONTROL PARAMETERS

Summary


Floating offshore Wind turbine
They allow upsizing while not representing ANY visual or noise pollution
Floating wind turbines constitute a solution to the problems onshore wind turbines have to face
INNOVATION is crucial for building more efficient systems
CONTROL is a way to optimize both the ENERGY PRODUCTION and the FATIGUE of the WIND TURBINE
the main challenge to serve the innovation is to lower the
LCOE