

# Joint industry Project 2C MORE

## Climate change impacts on offshore wind energy

### MOTIVATION & BACKGROUND

In France, the cumulative offshore wind capacity is expected to reach 45 GW by 2050. However, will offshore wind farms remain profitable in 2050, and at the end of their lifespan, in 2080 or 2100 due to climate change?

Over the next few decades, wind resources might evolve and differ from current estimates derived from hindcast databases, leading to changes in wind energy production and impacting the business plans established during their creation. Will these changes be positive or negative for the offshore wind industry?

Climate change could also affect the length and intensity of seasons, impacting the balance between supply and demand in the energy sector. Will there be compound events of cold waves and wind droughts that could threaten the energy balance?

The intensity and frequency of extreme metocean events may change during the next decades, affecting the design of all wind farms components. Is it possible to assess the impacts of these developments, due to climate change, in terms of design conditions?

### OBJECTIVE

To assess the climate change impacts on the offshore wind industry, focusing on the evolution of wind power and modifications of design conditions, with an evaluation of associated uncertainties

Duration: 36 months | Start: 2025 | Total budget: €2,400K

### DELIVERABLES

- Improvement of knowledge on metocean evolutions in the future (2050 and 2100 horizon), with associated uncertainties evaluation
- Advanced mathematical approaches for regional climate data bias correction, studies of extreme weather events and quantification of uncertainties
- New wave climate datasets
- Recommendations for adapting the design of offshore wind turbine systems to future climatic conditions based on structural sensitivity analysis
- Recommendations for the resilience of power cables based on the study of the effects of climate change on their design and durability in the landfall zone

# WORK PLANNED

## 1. Impacts of climate change on atmospheric variables

- Evaluation of wind climate models over historical period using reanalyses and *in situ* observations, emphasizing diurnal, seasonal cycles, inter-annual variability, complete distributions, and extremes
- Study of climate projections to assess the future impacts of climate change on key variables for offshore wind, including the evolution of compound events affecting the grid

## 2. Impacts of climate change on ocean variables

- Benchmark of wave climate datasets over historical period
- Implementation of a new global wave model in climate mode based on WAVEWATCH III®
- Use of super-resolution methods for coastal wave modelling using machine learning on a study site
- Determination of the impact of climate change on wave parameters and other oceanic parameters

## 3. Mathematical methods for climate sciences

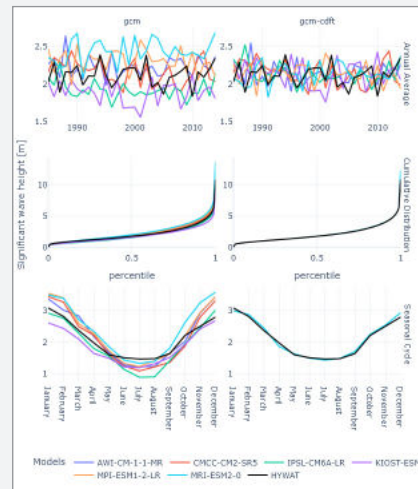
- Analysis and application of statistical downscaling and bias correction methods for all atmospheric and oceanic variables
- Extreme analyses of metocean parameters in a climate change context
- Development of uncertainty quantification methods using tools, like data assimilation methods or machine learning algorithms

## 4. Offshore wind applications of climate change impacts

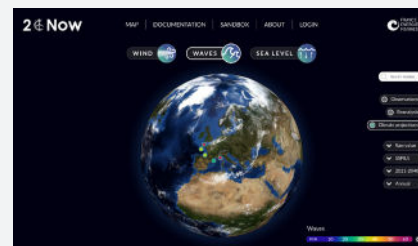
- Assessment of the producible output evolution
- Study on offshore wind turbines design calculations, including foundation or floater
- Quantification of the coastline evolution and of its implications for the landfall zones of power cables

## 5. Transfer to industry

- Development of an on-line platform
- Integration of tools and case studies



Comparison of annual mean and cumulative distribution function (mean over the stations) for different French coasts (@ 2C NOW)



Graphical interface of the on-line platform developed during 2C NOW project (@ France Energies Marines)

# PARTNERS

The project is led by France Energies Marines and RTE.



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