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## Our Journey Through Research and Innovation

# FibreGY Sum up

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# SUMMARY


- FIBREGY's main goal is to enable the extensive use of FRP materials in the structure of the next generation of large offshore platforms .
- The project will develop and qualify FRP materials for offshore applications, elaborate new design procedures and guidelines, generate efficient production, monitoring methodologies, and validate and demonstrate advanced software analysis tools.
- To ensure the industrial relevance of the project outcomes, the different activities will be focused on two promising offshore energy concepts, which will be re-engineered.
- The different technologies to be developed in FIBREGY will be demonstrated by using advanced simulation techniques and building a real-scale prototype.
- Different LCA studies will be carried out to evaluate the impact of the proposed options.


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# Research on high performance/cost ratio FRP materials

## YESTERDAY

- → Lack of experience in the use of FRP for structural components of offshore platforms
- → Lack of criteria for the selection of FRP materials for structural components of offshore platforms
- → Uncertainties in the characterization of the mechanical and fatigue of new FRP materials
- → No/scarce experience in the use of (new) thermo-plastics and bio-resins in the offshore industry

## TODAY

- → Use of FRP in offshore platforms demonstrated in medium/real scale
- → Multi-criteria selection matrixes for FRP materials developed
- → Strength and fatigue characterized for selected materials
- → New procedure for characterizing fatigue performance of materials based on S-P rule of mixture
- → Thermo-plastics (higher recyclability) and bio-resins characterized and demonstrated

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# Design procedures and guidelines, efficient production techniques

## YESTERDAY

- → Lack of design / assessment (experience and) guidelines for large offshore FRP structures
- → Lack of knowledge about the different joining techniques for large FRP components (including hybrid material solutions)
- → Lack of knowledge about the different manufacturing techniques of FRP structures for offshore applications

## TODAY

- → W2Power and Tidetec's turbine re-engineered using FRP materials (demonstrated)
- → New Project Guidelines for the Design of Offshore Floating Platform using FRP
- → Multi-criteria selection tool for different connection solutions/applications
- → Different manufacturing techniques and modular production strategies have been analyzed and qualified (partially demonstrated)

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FibreGY focuses on FRP, but it extends beyond that.

Several developed solutions are versatile and applicable to any type of offshore structure.

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# Advanced computational and structural health monitoring solutions

## YESTERDAY

- → Drawbacks / lack of efficient hydro-elastic tools for analysis / assessment of offshore platforms (specially for multi-turbines)
- → Lack of methodologies for efficient evaluation of lifespan of offshore structures.
- → Lack of inspection and maintenance methodologies, relying on the application of digital twin / SHM.

## TODAY

- → New (computationally efficient) hydro-elastic tools for analysis / assessment of (multi-turbine) offshore platforms (demonstrated)
- → New methodology for the creation of Physics-Based Digital Twins of offshore wind platforms (demonstrated)
- → New Digital Twin-based Structural Health Monitoring concept (demonstrated)
- → Paved the way for:
  - → Efficient and accurate remaining useful life evaluation + lifespan extension
  - → Streamlined inspection/maintenance plan (predictive maintenance of the structure)

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# Other achievements

## YESTERDAY

- → Traditional protective coatings and anti-fouling solutions based on liquid paints
- → Traditional sensor solutions for SHM
- → Lack of knowledge about the cost-effectiveness of the FRP structural solutions for offshore platforms
- → Lack of knowledge about the LCC of the FRP structural solutions for offshore platforms

## TODAY

- → Performance assessment of innovative (dry) paint films
- → Solutions for embedding sensor analyzed and qualified (partially demonstrated)
- → Cost-effectiveness analysis of the new concepts and solutions
- → Exploitation analysis (business plan) for the different solutions developed in the project
- → Life-Cycle Assessment (LCA) of the FRP re-engineered platforms

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# Main achievements through deliverables

**WP1**
- Market analysis and qualitative benefits / Cost-benefit analysis

**WP2**
- Catalogue of FRP materials (selection and experimental data)
- Fatigue performance of composites (experimental data) PUBLIC
- Environmental protection of composites (experimental data of dry coatings) PUBLIC
- Connections (analysis and multi-criteria matrix tool) PUBLIC

**WP3**
- Fatigue assessment criteria for FRP structures and computational model
- Aero-hydro-servo-elastic solver for multi-wind turbines
- Structural digital twin model

**WP4**
- Critical review of applicable standards and gaps identification PUBLIC
- W2Power redesign in FRP
- Turnable Tidal Turbine design in FRP

**WP5**
- Design and workplan for manufacturing the different demonstrators

**WP6**
- Middle scale test on dry coatings and connections (experimental data) PUBLIC
- Construction of the demonstrators: W2Power tower, turbine housing and real-scale module of W2Power OPEN INDUSTRIAL DAYS
- Analysis of the SHM data from sea trials

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# Concluding remarks on costs

## YESTERDAY

- → Lack of design / assessment guidelines for large offshore FRP structures
- → No experience in the design of large FRP-based offshore platforms' structure
- → No experience in the production of large FRP-based offshore platforms

## TODAY

- → New Project Guidelines for the Design of Offshore Floating Platform using FRP
- → W2Power and Tidetec's turbine re-engineered using FRP materials
- → Built medium and large scale demonstrators + sea trials on the W2Power's prototype towers
- → FibreGY has paved the way, but:
  - Designs not fully based on the new guidelines
  - Yet limited weight reduction (30%-40%)
  - Production processes based on available resources

## TOMORROW

- → Based on a sensitivity analysis, with the current production processes, a weight reduction of 50% is required to obtain a favorable FRR (8.15%) compared to steel construction (W2Power)
- → Internal analyses suggests that there is still room for additional weight reduction beyond 50% (new guidelines + direct analysis)
- → FRP manufacturing can largely benefic from existing (and future) industrial production processes
- → Some components (e.g. towers) more 'easily' industrialized could be cost-competitive 'now'
- → Other effects to consider (e.g. changes in the steel / FRP cost ratio)

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# THANKS FOR YOU ATTENTION