Our Value Proposal in Wind Energy

**Energy**
- Power electronics
- Control Hardware
- Grid Integration
- Solutions for HVDC Evacuation
- Hydrogen and Energy Storage

**Offshore systems**
- Design and optimization of offshore structures and systems
- Innovation for cost reduction
- Digital Twins
- Testing of components

**Smart Manufacturing**
- Manufacturing analytics
- Sensory and IoT Systems
- Machine Vision
- Additive Manufacturing
- Flexible Robotics

**Data Science for Early Fault Detection and Prognosis**
- Smart Systems for Condition and Structural Health Monitoring (CM & SHM)
- Other Digital Technologies for O&M

**Digitalization for Operation and Maintenance**

**Materials**
- Composites
- Metallic solutions
- Concrete
- Surface engineering
- Materials for Harsh Environments

**Circular Economy**
- Treatment at the end-of-life
- Recycling processes
- Sustainable chemistry
- Validation and characterization of materials
- Supporting tools for circular economy and decarbonisation
Our proposal value in OFFSHORE SOLUTIONS

Design and optimization of offshore structures and systems
- Foundations
- Mooring systems
- Dynamic cables
- Marine operations
- Electrical lay-out
- etc.

Digital Twins
Digital twins of components for offshore applications to support
- Life extension
- Operation
- Maintenance
- Redesign

Innovation for cost reduction
Generation, modeling and evaluation of innovative concepts for cost reduction in offshore renewables
- System engineering and decision tools to support on the development of floating wind farms at pre-FID (Final Investment Decision) stage
- Coupled, analytical and multi-physical models, including testing and validation
- Experimental modelling based on data analytics and deep learning
- Physical and virtual sensing

Testing of components
Testing of components for offshore applications in real conditions.
OFFSHORE SYSTEM

Some Relevant Achievements

- Research applied to innovative and integral solutions for foundations, towers and auxiliary systems of high power offshore wind turbines (SEAPOWER)
- Research and development of a new floating substation concept for offshore wind (WIND2GRID)
- Integral solution for floating wind O&M through the development of new technologies (FLOAT&M)
- Qualification of innovative floating substructures for 10MW wind turbines and water depths greater than 50m
- Development and demonstration of an automated, modular and environmentally friendly multi-functional platform for open sea farm installations of the Blue Growth Industry (The Blue Growth Farm)
- Innovative umbilical power connection system specifically designed for offshore renewable energy converters (KONEKTA2)
- Installation of submarine cables with remote vehicles (SCARGO)
- New generation of smart, competitive and sustainable mooring systems (BIZIMOOR)

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Our proposal value in ENERGY

**Power Electronics**
- Multilevel converters.
- Control algorithms for wind turbines.
- Solutions for connection wind turbines-DC collector systems.

**Control Hardware**
- Products based on control hardware and software.
- Complex architectures of embedded systems.
- Signal conversion and adaptation Hardware.
- Support to Hardware manufacturing.

**Grid Integration**
- Integration of offshore wind energy in AC and DC grids.
- Analysis of grid stability of power systems with high penetration of renewable energy.
- Analysis of regulations in different countries and adaption of models.

**Solutions for HVDC Energy Evacuation**
- VSC-HVDC converters (MMC).
- Control algorithms for: Point to point (P2P); Multiterminal.
- Offshore wind energy DC grids optimization and integration in AC grids.

**Hydrogen and Energy Storage**
- Hydrogen generation - electrolizer.
- Hydrogen transport in offshore wind farms.
- Electrical storage systems including BMS, EMS and battery twins.
ENERGY

Some Relevant Achievements

- Integrated Design and Control of Offshore HVDC Networks (IDeCON)
- Platform for the aggregation of flexibility from demand side resources (PowerFlex)
- System for controlling the energy production deviations in hybrid power plants (DOME - Dynamic Output Manager of Energy)
- Techno-economic analysis and sizing of storage systems (SCORE)
- New Technologies to Increase Power Density in Electronic Converters (CONVAP)
- Hydrogen-aolic energy with optimised electrolyser upstream of substation (HAEOLUS)
- Technologies to boost the hydrogen economy in the Basque Country: green hydrogen generation (H2BASQUE)
- Industrial research for the transport and logistics of hydrogen generated in offshore wind farms (HyShore)

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Our proposal value in SMART MANUFACTURING

**Manufacturing Analytics**
- Zero-Defect Manufacturing
- Predictive Maintenance and Improved Availability of Assets
- Optimisation of Consumption and Energy Efficiency
- Safety for People (Operator 4.0)
- Big Data on Production/Quality Data
- Product Traceability

**Sensory and IoT Systems**
- Extraction and management of process data and related assets
- Data processing and information generation.
- Decision-making preparation.
- Ubiquitous and secure access to information (cybersecurity).
- Secured traceability of data via Blockchain throughout the supply chain.

**Machine Vision**
- Quality control: Surface inspection – Deflectometry for reflective surface
- Process control: Thermography
- On line 2D and 3D measurement in cold and hot conditions

**Additive Manufacturing**
- Additive processes and materials for:
  - Flexible manufacturing of parts.
  - Customized manufacturing.
  - Big materials savings.
  - Easiness for on-site repairments.
  - Reduction in dimensions and superficial defects.

**Flexible Robotics**
- Collaborative robotics (i.e. cable robotics)
- Process smart automation.
- Optimisation and automation of intralogistic flows.
- Easy-programming and teach-by-demonstrator of robotics platforms.

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SMART MANUFACTURING

Some Relevant Achievements

- Development of manufacturing 4.0 technologies in the Basque wind industry (WIND 4.0).
- Proactive Quality Control System to avoid End of Line defects (MUPROD).
- Monitoring systems based on the cloud to automatic registration and analysis of data from PLCs (VIXION).
- SMART SENSORS for manufacturing tooling and fixtures.
- Real-time automatic surface inspection system (SURFIN).
- Self Tooling Additive Technology (STAT) process.
- New 3D printing-building methods for towers with cementitious materials.
- Cable robotics for handling and assembly.

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Our proposal value in DIGITALIZATION FOR OPERATION AND MAINTENANCE

Data Science for Early Fault Detection and Prognosis
- Machine Learning: for reinforcement Learning; fairness, accountability, transparency, cybersecurity, intelligent optimization, robotics; among others.
- Deep Learning: Efficient, continuous and incremental learning processes; anomaly detection; IA explainability; DevOps
- Development of digital models for O&M of energy assets: involving Soft sensors; physical model calibration with real data; generation of synthetic failure data; life index estimation; among others.
- High performance computing and development of data space solutions based on IDS and GAIA-X for the secure sharing of data and models, including interoperability, authentication, usage control and traceability services.

Smart Systems for Condition and Structural Health Monitoring (CM & SHM)
- Real-time corrosion remote monitoring
- Ad-hoc instrumentation technologies for specific CMS and SHM solutions
- Control and communications optimization.

Other Digital Technologies for O&M
- Cybersecurity, risk and vulnerability assessment. Certification.
- Secured architectures, Authentication & authorization, Certification. Asset management
- Blockchain based malware detection. Domain rule-based detection.
- Blockchain platforms for component restoration.
- Augmented Reality and remote assistance.

Meteorological forecasting and monitoring for O&M
- Meteorological and climatological observation, analysis and information services: Surveillance and monitoring (24×7), support in decision-making, numerical and statistical modelling…
- Numerical, statistical and modelling tools to provide and to analysis meteorological and climate information
DIGITALIZATION FOR OPERATION AND MAINTENANCE

Some Relevant Achievements

- Monitoring system for life extension structural components (DasWind).
- Digital PLAtform and analytic TOOlS for eNergy (PLATOON)
- Data Driven Predictive Maintenance Models (LEO)
- Magnetic robot for wind turbine blades inspection (EOLOS)
- Digital twin of wind turbine drivetrain for predictive maintenance
- Image-based Deep Learning for damage detection
- Cyber-secure architectures and communications in windfarms for Resilient and Self-healed Electrical Power Nanogrid (ELECTRON)
- Blockchain for traceability of the supply chain (TRACEBLOCK)
Our proposal value in MATERIALS

Composites
- Sustainable composite materials: Liquid moulding | biobased-resins | Composites for recycling and reusing; and for waste valorisation.
- Multifunctional composites and surfaces: Integration of different elements (anti-icing, sensoring, fire resistance…) | Smart micro/nano capsules | Polymer/resin modification | Selection of optimum additive(s)
- Efficient and competitive manufacturing processes for composites: New joining technologies | Simulation and optimization | Monitoring and control | 4.0 solutions | Tooling | Automation

Metallic Solutions
- Design and selection of new alloys: CALPHAD methodology and computational tools for substitution of critical materials, weight reduction or properties enhancement, time and cost reduction
- Novel metallic alloys (corrosion, fatigue, weight, cost reduction…): New steel grades | Alloyed cast iron | Nanostructured aluminum alloys | Materials homologation.
- Manufacturing processes: Casting, steelmaking, metal forming, forging, PM, AM, thermal spraying, welding, joining… | 4.0 solutions.

Concrete
- Ultrahigh Performance Concrete:
- Self healing system (sealing of micro-cracks) that increase concrete durability

Surface Engineering
- Advanced and multifunctional surfaces: anti-ice, self-cleaning, UV light resistance, erosion/wear, corrosion, low friction… for polymeric, ceramic, metallic and composite materials
- Nano / micro textured surfaces: modifying wettability, iridescence, AR, among others
- Functional printing: Embedding of sensors or functional layers (e.g. heating elements) in composites.

Materials for Harsh Environments
- Materials for offshore environments.
- Corrosion protection methods
- Support for the fulfillment of the environmental strengths and reduction of the costs.
- Early detection of corrosion and remote monitoring.
- Diagnostics.
MATERIALS

Some Relevant Achievements

- Resistive heating layers of CNT Buckypapers or tailored carbon fiber circuits embedded during blade manufacturing process.
- New alluminium based alloys for Wind Turbine: Bell Housing
- Non-metallic fiber-reinforced concrete formulations leading to high strength concrete (Ultrahigh performance concrete)
- New materials, coatings and processes to improve the competitiveness of the Basque industry in marine renewable energies (NEOMAT)
- Technologies for the design, advanced manufacturing and validation of materials and components for offshore energy installations (HARSH)
- Biobased products: New polycarbonates and isocyanate-free polyurethane paints derived from biomass
- Top-coat on galvanized structural steel, for the corrosion protection of galvanized steel screws used in eolic towers
- Innovation Eco-system to Accelerate the Industrial Uptake of Advanced Surface Nano-Technologies (NEW SKIN)

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Our value proposal in CIRCULAR ECONOMY

Treatment at the end of life
- Waste management
- Technologies for dismantling
- Re-manufacturing
- Recycling
- Materials circularity

Recycling processes
- Mechanical. Use of recovered material: into precast concrete elements or multilayer panels; for 3D printing.
- Thermal. Recovery of matrices and reinforcement fibres | Use of recovered material into plastic and composites.
  - Chemical: For plastic and composites: Solvolysis: Deep Eutectic Solvents (DES); Ionic Liquids (ILs) | Thermochemical: Gasification; pyrolysis
  - Rare Earth Element (REE) and Rare Earth Alloys (REA) valorization

Sustainable Chemistry
- Biobased products: bioreins, bio coatings, biopaints…
- Sustainability by design materials: new resins that are recyclable.
- Synthesis of non toxic and biodegradable bio-lubricants from vegetable oils and their derivatives.

Validation and characterization of materials
- Erosion resistance and damage assessment.
- Multifactor and multisite life/degradation studies.
- Tribo-performance.
- Design and implementation of ad hoc evaluation procedures.
- Certified lab (ENAC).

Supporting tools for circular economy and decarbonisation
- Tools for supporting industrial and organizational sustainability
- Integration of circular economy in business models
- Eco-design
- Design for end-of-life (recycling, reusing…)
- Strategy and plans for a competitive decarbonization of the industry
CIRCULAR ECONOMY

Some Relevant Achievements

- Wind Turbine Blades decommissioning and mechanical recycling with material recovery for new applications in the construction sector (LIFEBRIO).
- Large scale demonstration of new circular economy value-chains based on the reuse of end-of-life fiber reinforced composite (FIBERUSE).
- Rare Earth Element (REE) mixtures extraction and Rare Earth Alloys (REA) production route from in-process and End-of-Life Permanent Magnets (PM) and NiMH waste (REE4EU).
- New plastic raw materials from chemical recycling technologies and processes for the industrial sectors of the Basque Country in an applied approach to the circular economy (NEOPLAST).
- Eco-design of electrical substations (NEOSUB).
- Low footprint carbon cement-based products.
- Operational life cycle sustainability assessment methodology supporting decisions towards a circular economy (ORIENTING).
- Digital platform for circular economy in cross-sectorial sustainable value networks (DIGIPRIME).

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Creating Growth Improving Society
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