Lo sviluppo tecnologico nel settore eolico offshore
I finanziamenti dal programma europeo Horizon Europe

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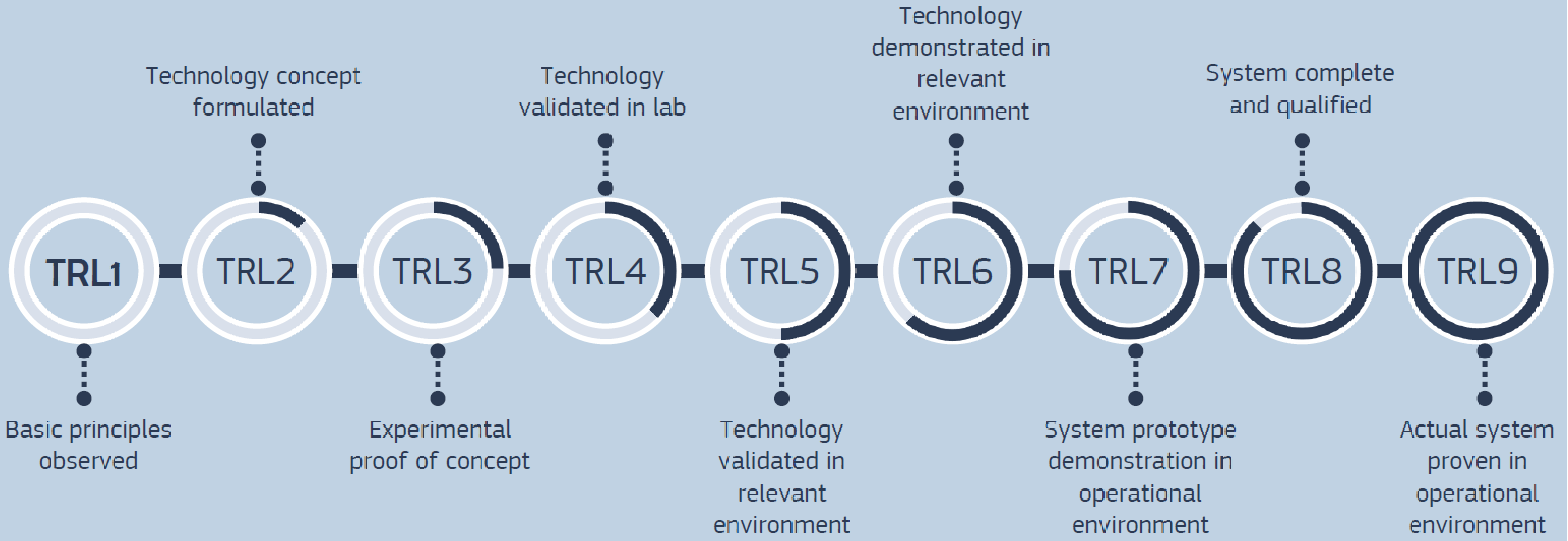
Technology readiness level (TRL) scale



Integrated wind farm control

Expected Outcome: The EU aims to be climate neutral in 2050, and to achieve this goal wind energy technologies will need to unlock its full potential on **low-cost reliable clean energy generation**. Thus, the **next generation of wind farms will need to be supported by an even more innovative set of physical and digital tools** as well as operational controls, collectively called **wind farm control**. Generally, wind farm control refers to the coordination of different wind turbines within a wind farm to better the overall farm power production, and to reduce the structural loading among wind turbines.

In this context, project results are expected to contribute to all of the following expected outcomes:

•Development of open source **data-driven tools to decrease energy costs on operation**, while increasing total wind farm output, and a parallel evaluation of operational risks arising from the chosen solution, including e.g. limitations from machine learning (AI) and resilience against third-party fraud, i.e. operational security.

•Development of **digital and physical tools**, as well as interoperable frameworks and controls, for enhanced data collection, analysis, and operation aimed at an improved performance at farm level.

•Allow operators to make better informed decisions on farm-wide system optimisation, **lifetime extension, decommissioning and/or recycling of components**.

•Contribute to **LCOE reduction** in line with the SET Plan targets (actions should clearly justify the estimated LCOE at project start and end).

Integrated wind farm control

Scope: The proposal is expected to address all the following aspects:

•Address and validate how digital innovation on wind farm control are able to provide more stable, resilient, secure, reliable and affordable energy, while retaining high levels of **cybersecurity**. Focus on farm output maximization is expected. Additionally, focus on reduced component load is strongly encouraged.

•Address how these data-driven innovations **reduce operational and maintenance costs**, **increase energy output, and their impact on (component, turbine, farm) lifetime**;

•Address the role of such innovations as a prognostic tool, regarding failures and damages:

•Develop and release an open source digital/AI solution for sector uptake. This tool is expected to be built from concrete experiments and data measurements. Further, **it should account for the advent of large wind turbines (up to 20 MW)** and include those in the development of this tool.

Project details:

Smart, Aware, Integrated Wind Farm Control Interacting with Digital Twins (ICONIC) (ICONIC)

ICONIC aims to develop innovative **physical and digital tools** to achieve fundamental breakthroughs for the integrated control of wind farms, considering the whole physical system at farm, turbine, and component levels, in particular the complex aerodynamic interactions among turbines. ICONIC **aims to increase farm-wide power production by 15-20% under optimal wind speeds and directions for typical wind farms suffering from wake effects**, with **a 3%-5% increase in annual energy production (AEP)** considering all working conditions over the long term. It targets an **LCOE reduction of at least 6%** compared with the state-of-the-art control tools deployed in the current wind industry by improving farm-wide AEP and reducing operation & maintenance costs via leveraging the latest AI and digital technologies. Extensive validations for the integrated wind farm control solutions will be conducted via high-fidelity simulation models, experiments at a national-level wind tunnel, historical operational data at BP's and C-Power's wind farms, a unique collection of test rigs for critical turbine components at respective companies, and real-world wind farm field tests at C-Power. ICONIC's integrated wind farm control system will contain (1) novel AI-based wind farm control system to unlock wind farms' full potential; (2) novel data-enhanced wind turbine controllers to fulfil farm-level commands while balancing power generation and load mitigation; (3) an integration with digital twins (DTs) as extra support to improve control and reduce costs, which contains a first-ever farm-level DT for wind farm flow systems replicating detailed physical flow fields and an innovative turbine-level DT with critical component models for loading and lifetime estimations; (4) extensions of the solutions to future 20MW turbines. ICONIC will establish new knowledge and industrial leadership in key digital, enabling and emerging technologies, and deliver next-generation tools for wind farm operation.

Project details:

Smart, Aware, Integrated Wind Farm Control Interacting with Digital Twins (ICONIC) (ICONIC)

Participants

- UNIVERSITEIT GENT - UGent**(999986096) - COORDINATOR**
- NORGES TEKNISK-NATURVITENSKAPELIGE UNIVERSITET NTNU - NTNU**(999977851) - BENEFICIARY**
- AALBORG UNIVERSITET - AAU**(999904034) - BENEFICIARY**
- KATHOLIEKE UNIVERSITEIT LEUVEN - KU Leuven**(999991334) - BENEFICIARY**
- IKERLAN S. COOP - IKERLAN**(999581315) - BENEFICIARY**
- C-POWER NV - **(884196226) - BENEFICIARY**
- EDR & MEDESO AS - **(910168364) - BENEFICIARY**
- LAU LAGUN BEARINGS SL - **(917994712) - BENEFICIARY**
- SKF BV - SKF**(994928031) - BENEFICIARY**
- ZF WIND POWER ANTWERPEN NV - ZF WPA**(999955153) - BENEFICIARY**

Project details:

Integrated, Value-based and Multi-objective wind farm control powered by Artificial Intelligence (TWAIN)

For reliable and affordable design and operation of wind power plants that also consider system-level stability and security as well as the surrounding natural and social environment, coordinated wind farm control (WFC) and asset management solutions play an important role. Additionally, given the urgency of growth implied by ambitious decarbonisation targets, artificial intelligence (AI) and other digitalisation concepts are major accelerators of the energy transition and a key enabler for integrating the processes and prospects of WFC technology into the operation and design of the future energy systems. To support wind farm owners/operators to make better decisions for system-wide optimised performance, **TWAIN's concept pivots on a full-integration of WFC at five different levels**: 1) integration of multi-source and multi-format data of varied nature from wind farms in different life stages; 2) AI-enabled integration of multi-disciplinary processes and phenomena affecting the wind farm operation; 3) integration of multi-objective prospects of WFC to assess the true added value of a certain operation mode; 4) integration of multi-level controllers and scenario analyses in decision support provision for harmonious co-existence of WPPs with their environment and society via optimised operation and design; and 5) integration of wider audience to TWAIN outcomes. TWAIN decision support environment is a digital environment architected for multi-source data integration and optimised computing, which contains a set of toolboxes with the critical analytical steps to operate a wind farm effective and efficiently. It is oriented to wind power asset management by WF owners/operators, considering as asset the WT and its components within a WF.

Participants

- DANMARKS TEKNISKE UNIVERSITET - TECHNICAL UNIVERSITY OF DENMARK DTU**(999990655) - COORDINATOR**
- FUNDACION CENER - CENTRO NACIONAL DE ENERGIAS RENOVABLES CENER**(999745342) - BENEFICIARY**
- TECHNISCHE UNIVERSITEIT DELFT - TU Delft**(999977366) - BENEFICIARY**
- TECHNISCHE UNIVERSITAET MUENCHEN - TUM**(999977463) - BENEFICIARY**
- F6S NETWORK IRELAND LIMITED - F6S IE**(900885658) - BENEFICIARY**
- CAPITAL ENERGY ENGINEERING SL **- (885993151) - BENEFICIARY**
- BELGISCH LABORATORIUM VAN ELEKTRICITEITSINDUSTRIE - LABORATOIRE BELGE DEL'INDUSTRIE ELECTRIQUE**(998728200) - BENEFICIARY**
- ENGIE GREEN FRANCE **- (907052045) - BENEFICIARY**
- ELECTRICITE DE FRANCE - EDF**(999926829) - BENEFICIARY**
- RAMBOLL DEUTSCHLAND GMBH - RAMBOLL**(997816400) - BENEFICIARY**
- SOFTSERVE POLAND SP ZOO **- (893660031) - BENEFICIARY**
- RAMBOLL DANMARK AS **- (999926635) - BENEFICIARY**

Project details:

Wholistic and Integrated digitaL tools for extended Lifetime and profitability of Offshore Wind farms (WILLOW)

Wind energy takes on a large share in the energy market and will play a crucial role in securing the stability of power grids in the future. However, operation of wind farms, and especially offshore wind farms, are not yet ideal. The operation in fluctuating conditions of wind availability and power grids demand as well as the harsh environmental condition where the offshore wind farms are built, have a negative effect on the structure health of the wind turbines, and therefore on their useful lifetime. In this context, **WILLOW will develop an integrated system that will provide an open-source, data-driven smart curtailment solution to the Wind Farm Operators** with the basis of an integrated Wind Farm Control system looking for a trade-off between the power production and the lifetime consumption. With this aim, WILLOW pretends to design a novel Structural Health Monitoring (SHM) System able to provide high quality data to perform a reliable fleet life assessment using physical models and data-based AI methods which will be used for decision-making and maintenance scheduling. This will contribute to the reduction of the Levelized Cost of Energy (LCOE) and to the increase of the Annual Energy Production (AEP) towards the current trend of design and operating life of offshore wind farms with up to 20 MW turbines beyond 50 years. The WILLOW consortium consists of 12 partners with complementary assets and founded expertise, capable to take on the challenge set out by the topic.

Participants

- ASOCIACION CENTRO TECNOLOGICO CEIT - Ceit**(999605662)** - **COORDINATOR**
- SINTEF ENERGI AS - **(999513221)** - **BENEFICIARY**
- SIRRIS HET COLLECTIEF CENTRUM VAN DE TECHNOLOGISCHE INDUSTRIE - SIRRIS LE CENTRE COLLECTIF DE L'INDUSTRIE TECHNOLOGIQUE**(998134075)** - **BENEFICIARY**
- VRIJE UNIVERSITEIT BRUSSEL - VUB**(999902094)** - **BENEFICIARY**
- FLANDERS MAKE - **(996435896)** - **BENEFICIARY**
- C-CUBE INTERNATIONAL BV - C-CUBE**(989242085)** - **BENEFICIARY**
- WOLFEL ENGINEERING GMBH + CO. KG - Woelfel**(998755554)** - **BENEFICIARY**
- ALERION TECHNOLOGIES SL - ALERION TECHNOLOGIES**(923126885)** - **BENEFICIARY**
- 24SEA - 24SEA**(911961700)** - **BENEFICIARY**
- TECNICAS Y SERVICIOS DE INGENIERÍA, S.L. - TSI**(996741252)** - **BENEFICIARY**
- NORTHER - **(887320984)** - **BENEFICIARY**
- CLUSTER DE ENERGIA - CEPV**(998235925)** - **BENEFICIARY**

Project details:

Sustainable resilient data-enabled offshore wind farm and control co-design (SUDOCO)

Wind energy is crucial for realizing climate neutrality, energy independence, and energy security. With the increased penetration of renewables in the electricity grid, there is a strong need for control technology to determine the number of electrons to produce and their destination (e.g., grid, storage, hydrogen) for maximum value to the energy system. Whereas the technology available on the market exclusively maximizes the energy yield, the future lies with optimization for cost of valued energy (COVE), which considers energy security, storage, fluctuating electricity prices, turbine component wear, and turbine lifetime. Therefore, **SUDOCO will develop open-source technology for resilient, and data-enabled offshore wind farm control and co-design**. We will use key aspects and insights in wind farm operation to develop the Control Room of the Future that will allow operators to control wind farm output and loads by minimizing the COVE. SUDOCO will combine novel dynamic control algorithms, hybrid physics-based and data-driven models for the design of physical farms considering their governing control laws, which are safeguarded against adversarial threats and third-party fraud. Our data driven integrated control tool chain will be trained, validated and optimized using several high-fidelity datasets. These include data from full-scale dedicated wake steering control experiments performed at the 69 11-MW turbines in the Hollandse Kust Noord wind farm. We will also perform unprecedented wind farm control experiments with scaled wind turbine models in the largest boundary layer wind tunnel in Europe. SUDOCO will target a **COVE reduction of 10%,** and includes means to minimize environmental impact as well as address the variability of the wind resource. SUDOCO will deliver the first intelligent integrated wind farm control and design solution for reliable, safe, and cost- effective operation of large bottom-fixed and floating offshore wind farms.

Project details:

Sustainable resilient data-enabled offshore wind farm and control co-design (SUDOCO)

Participants

- TECHNISCHE UNIVERSITEIT DELFT - TU Delft**(999977366) - COORDINATOR**
- YOUWIND CAPITAL SL - Youwind Renewables**(883984087) - BENEFICIARY**
- DANMARKS TEKNISKE UNIVERSITET - TECHNICAL UNIVERSITY OF DENMARK DTU**(999990655) - BENEFICIARY**
- TECHNISCHE UNIVERSITAET MUENCHEN - TUM**(999977463) - BENEFICIARY**
- FONDAZIONE ICONS - ICONS**(917939810) - BENEFICIARY**
- SHELL GLOBAL SOLUTIONS INTERNATIONAL BV - SHELL**(999425242) - BENEFICIARY**
- POLITECNICO DI MILANO - POLIMI**(999879881) - BENEFICIARY**
- SOWENTO GMBH - **(903752493) - BENEFICIARY**

Topic text: CL5-2023-D3-01-05

Critical technologies for the offshore wind farm of the Future

(Enrico DEGIORGIS– DG RTD)

European Commission

D3-01-05: Critical technologies for the offshore wind farm of the Future

Scope (1/3):

- **The objective** is to bring major innovations in the design and manufacturing of large offshore wind farms, aiming at >15 MW for fixed bottom offshore applications **OR** >12 MW for floating offshore installations.
- **Attention can be paid** to substantially reducing the wind turbine mass (rotor/nacelle/tower) as well as on advanced lean marine-compatible substructures, advanced (dynamic) cabling and connectors, including floating platforms and its moorings. Innovations such as compact generators, smart blades, reliable drive trains, **can be investigated** alongside new turbine designs.
- Innovative low-cost substructures with suitable geotechnical and hydro-dynamic properties **should be developed** using long-lasting, anti-fouling, corrosion resistant materials with high damping properties.

D3-01-05: Critical technologies for the offshore wind farm of the Future

Scope (2/3):

- The projects **should** exploit improved understanding of the issues related to materials in the upscaling of wind energy turbines/systems (stresses and strains, delamination, etc.)

- The innovations **should** contribute to sustainability considering circularity in the design phase, less (or no) use of (critical) raw materials and decreasing negative environmental and social impacts. They should also contribute to the mitigation of the possible impacts to protected species and habitats.

- Such development will allow further deployment of offshore wind energy conversion systems and dramatically increase the offshore wind potential while reducing public acceptability barriers (noise, visual impact).

D3-01-05: Critical technologies for the offshore wind farm of the Future

Scope (3/3):

The active participation of relevant industrial partners and technology suppliers **is essential** to form a multisectoral, multidisciplinary consortium able to achieve the full impact of the project.

Specific Topic Conditions:

Activities are expected to achieve TRL 5 by the end of the project – see General Annex B.

D3-01-05: Critical technologies for the offshore wind farm of the Future

Project results are expected to contribute to all of the following outcomes:

- Improved performance of offshore wind turbines and efficient use of the marine space.
- Reinforced European offshore wind turbine value chain, supporting local companies and creating local jobs and skills.
- Reduce the possible impacts of offshore wind turbines on protected species and habitats.
- Reduced use of primary raw materials and reduced dependency on scarce raw materials.
- Reduction of LCOE and increased sustainability.

Project details:

Innovative circular materials and design methods for the development of Floating Wind Turbine components for offshore Wind Farms of the future (MADE4WIND)

MADE4WIND aims to develop and test innovative components' concepts for a 15MW offshore Floating Wind Turbine (FWT) consisting of **new designs and manufacturing techniques for blades, substructure, and drivetrain**. The main results obtained in the project will be: - Novel FWT component design (and validation at reduced-scale): Lighter and recyclable WT blades; **Improved Tension-Leg PlatformsTLP substructure (including lightweight floater concept, smaller gravity anchor and lighter tendons**); and Improved drivetrain design (by a Compact generator with less rare-earths, and more reliable converter). - **New material applications**: new blade toughening material; new concrete; and Aluminum rebars for floating substructure. - **New manufacturing processes**: Preform for manufacturing blades. - Recyclability/Reuse of composites from Blades, concrete from substructure, and Aluminum rebars. - **New software tools**: Novel maintenance strategy and remote control systems; Improved modelling tool for LCoE analysis; Virtual model of 15MW FWT. - Guidelines: Integrated sustainability assessment; Biodiversity protection strategy; Training pathways for offshore wind local industry; Position paper with Offshore Wind stakeholders. These innovations will jointly allow future FWT to include new circular lightweight materials, minimize the impact of sea habitats, increase operational availability, reduce maintenance needs and minimize LCoE; thus, unlocking the massive deployment of >15MW floating WFs in Europe and worldwide. Partners' expertise will be key for project success, as they cover different expertise along the offshore wind value chain: Academia (SINTEF, AAU, NTNU, IFEU), consultancy (ZABALA), material suppliers (Norsk Hydro, Fibertex), WT components manufacturers (Acciona, Ingeteam, Indar) and WT manufacturer (Siemens-Gamesa). Moreover, in addition to partners' research skills, MADE4WIND proposes a strong dissemination plan, clustering with relevant Offshore Wind stakeholders, to maximise future impacts.

Project details:

Innovative circular materials and design methods for the development of Floating Wind Turbine components for offshore Wind Farms of the future (MADE4WIND)

Participants

- SINTEF AS - SINTEF**(910945140)** - **COORDINATOR**
- AALBORG UNIVERSITET - AAU**(999904034)** - **BENEFICIARY**
- NORGES TEKNISK-NATURVITENSKAPELIGE UNIVERSITET NTNU - NTNU**(999977851)** - **BENEFICIARY**
- SIEMENS GAMESA RENEWABLE ENERGY AS - SGRE-DK**(986360215)** - **BENEFICIARY**
- ACCIONA CONSTRUCCION SA - **(999812854)** - **BENEFICIARY**
- INGETEAM POWER TECHNOLOGY SA - INGETEAM**(953914588)** - **BENEFICIARY**
- INGETEAM INDAR MACHINES SA - INGETEAM**(917770545)** - **BENEFICIARY**
- NORSK HYDRO ASA - NHY**(937314202)** - **BENEFICIARY**
- FIBERTEX NONWOVENS A/S - FIBERTEX NONWOVENS A/S**(882671289)** - **BENEFICIARY**
- IFEU - INSTITUT FUR ENERGIE- UND UMWELTFORSCHUNG HEIDELBERG GGMBH - IFEU**(999703826)** - **BENEFICIARY**
- ZABALA BRUSSELS - ZABALA BRUSSELS**(908114874)** - **BENEFICIARY**

Project details:

Developing the Next Generation of Environmentally-Friendly Floating Wind Farms with Innovative Technologies and Sustainable Solutions (FLOATFARM)

FLOATFARM aims to significantly advance the maturity and competitiveness of floating offshore wind (FOW) technology by increasing energy production, achieving significant cost reductions within the design and implementation phases, improving offshore wind value chain and supporting EU companies in this growing sector. Ultimately, FLOATFARM aims to decrease negative environmental impacts on marine life and to enhance the public acceptability of FOW, thereby accelerating the EU energy transition. To this end, a number of critical technologies have been identified as key catalysts. They apply to different conceptual scales, from individual floating offshore wind turbine level (Action 1) to farm level (Action 2) and environmental and socio-economic perspectives (Action 3). Innovations will be introduced into: 1) ROTOR TECHNOLOGY, where innovative rotor designs for improved energy capture will be explored in a co-design approach with innovative control techniques, improved floaters, and a groundbreaking generator concept; 2) MOORING AND ANCHORING, where shared mooring and innovative dynamic cabling will be investigated; 3) WIND FARM CONTROL, where novel control strategies will be exploited to increase the farm power density, and 4) ENVIRONMENTAL IMPACT MITIGATION, where marine noise emissions and impacts on marine species of FOW farms will be addressed, innovative artificial reefs will be pioneered and social acceptance will be studied. To ensure that effective solutions are pursued and TRL5 can be achieved, FLOATFARM adopts a holistic approach that combines innovative designs, experimental demonstration at laboratory scale, modelling with a suite of beyond state-of-the-art numerical tools, and demonstration in a unique open-sea laboratory, where a new 1:7 scale 15MW FOWT will be tested in combination with novel floaters, moorings and controls, ensuring systematic assessment and validation that are thus far unprecedented in FOWT research.

Project details:

Developing the Next Generation of Environmentally-Friendly Floating Wind Farms with Innovative Technologies and Sustainable Solutions (FLOATFARM)

Participants

- TECHNISCHE UNIVERSITAT BERLIN - TUB**(999986678)** - **COORDINATOR**
- UNIVERSITA DEGLI STUDI DI FIRENZE - UNIFI**(999895789)** - **BENEFICIARY**
- ECOLE CENTRALE DE NANTES - ECOLE CENTRALE DE NANTES**(999509050)** - **BENEFICIARY**
- TECHNISCHE UNIVERSITEIT DELFT - TU Delft**(999977366)** - **BENEFICIARY**
- UNIVERSITEIT GENT - UGent**(999986096)** - **BENEFICIARY**
- DANMARKS TEKNISKE UNIVERSITET - TECHNICAL UNIVERSITY OF DENMARK DTU**(999990655)** - **BENEFICIARY**
- SAIPEM SA - **(996443656)** - **BENEFICIARY**
- SOWENTO GMBH - **(903752493)** - **BENEFICIARY**
- NEXT OCEAN BV - **(910266237)** - **BENEFICIARY**
- SEAPOWER SCRL - **(920942154)** - **BENEFICIARY**
- INNOSEA - INNOSEA**(941405274)** - **BENEFICIARY**
- CONSIGLIO NAZIONALE DELLE RICERCHE - CNR**(999979500)** - **BENEFICIARY**
- BLUE OCEAN SUSTAINABLE SOLUTIONS LDA - **(888908583)** - **BENEFICIARY**
- FRANCE ENERGIES MARINES - **(897214208)** - **BENEFICIARY**
- HAGNESIA WIND AB - **(884420490)** - **BENEFICIARY**
- EURONOVIA - Euronovia**(940140394)** - **BENEFICIARY**

Project details:

Sustainable station-keeping systems for floating wind (TAILWIND)

To meet EU net zero targets requires a six times increase in offshore wind deployment rate, primarily in deep seas where floating offshore wind (FOW) is needed. To achieve this growth requires FOW to be economic, sustainable and supported by a wide supply chain. TAILWIND is focused on station-keeping systems of FOW, which comprise mooring lines and anchoring systems. The project will unlock identified opportunities for cost reduction, reduced environmental impact and material use, and also supply chain diversification. **TAILWIND will integrate new experimental evidence, novel technologies and innovative methodologies, across mooring lines and anchors**, and will quantify the resulting benefits for the overall floating system design. All innovations will be sustainable-by-design, integrating environmental, societal and economic benefits. For mooring lines, new synthetic rope technologies will be mechanically and chemically tested to demonstrate their suitability for small-footprint 'taut' moorings, validating new response models. For anchoring, geotechnical centrifuge testing and advanced soil element testing will underpin two advances: (i) new response models for the long-term loading particular to FOW, and (ii) the validation of novel anchors types including cluster anchors that are "silently" installed from small vessels and are suited to shared moorings. The new technologies for mooring lines and anchors will allow smaller and lighter station-keeping systems, manufactured and installed by a wider supply chain. TAILWIND will distill the models into system optimisation tools, unlocking further floater optimisation and cost reduction. Finally, an integrated life cycle assessment will quantify the economic, social and environmental impact of TAILWIND's technologies. TAILWIND unites a diverse consortium of 12 organisations from 8 European countries, located across the emerging FOW development regions, and spanning academia, consulting, construction and manufacture.

Project details:

Sustainable station-keeping systems for floating wind (TAILWIND)

Participants

- STIFTELSEN NORGES GEOTEKNISKE INSTITUTT - NGI**(998866522) - COORDINATOR**
- TECHNISCHE UNIVERSITEIT DELFT - TU Delft**(999977366) - BENEFICIARY**
- DANMARKS TEKNISKE UNIVERSITET - TECHNICAL UNIVERSITY OF DENMARK DTU**(999990655) - BENEFICIARY**
- SINTEF OCEAN AS - SO**(997806603) - BENEFICIARY**
- FUNDACION TECNALIA RESEARCH & INNOVATION - TECNALIA**(999604110) - BENEFICIARY**
- NAUTILUS FLOATING SOLUTIONS SOCIEDAD LIMITADA - NAUTILUS**(925375733) - BENEFICIARY**
- BEKAERT WIRE ROPE INDUSTRY NV **- (908626840) - BENEFICIARY**
- SUBSEA 7 NORWAY AS **- (892447628) - BENEFICIARY**
- FONDAZIONE ICONS - ICONS**(917939810) - BENEFICIARY**
- CLARKE MODET Y COMPANIA S.L. **- (950614551) - BENEFICIARY**
- NKT CABLES GROUP A/S **- (880961664) - BENEFICIARY**

Project details:

Integrated Designs for Future Floating Offshore Wind Farm Technology (INF4INiTY)

The importance of an increased exploitation of renewable energy sources is highlighted by the recent geo-political events with their impact on energy security and pricing, together with the global efforts to mitigate the anthropogenic climate change. Floating offshore wind, with its tremendous potential, will play an important role in the future to achieve the European Commission's ambitious goals towards a climate-neutral energy transition. However, the required expansion of floating offshore wind capacity to achieve, e.g., the EU's SET Plan targets, challenges the goal to protect and preserve bio-diversity (habitats and species) in the EU sea basins as set forth, e.g., by the Mission Healthy oceans. The INF4INiTY project (INtegrated designs for Future Floating oFFshore wINd farm TechnologY) aims to support the solution of this challenge. By developing critical technologies for the offshore wind farm of the future which enable balancing human needs (clean energy) with nature's and society's demands (decreased negative environmental and social impact). In particular, INF4INiTY provides two major technology innovations: an innovative nature inclusive design for gravity anchors and their associated scour protection system and (2) an innovative primary artificial reef structure combined with the floating structure of a floating offshore wind turbine. To that end, INF4INiTY combines world class numerical modelling and experimental analysis expertise with leading industrial technology development. Being immersed in a holistic techno-environomic, multi-level, multi-objective optimisation framework, INF4INiTY's technology development results in truly innovative, economically viable, and sustainable solutions for the current techno-socio-enviro-economic challenges of the floating offshore wind industry.

Project details:

Integrated Designs for Future Floating Offshore Wind Farm Technology (INF4INiTY)

Participants

- TECHNISCHE UNIVERSITAET BRAUNSCHWEIG - **(999861257) - COORDINATOR**
- GOTTFRIED WILHELM LEIBNIZ UNIVERSITAET HANNOVER - LUH**(999981828) - BENEFICIARY**
- WIKKI GESELLSCHAFT FUR NUMERISCHE KONTINUUMSMECHANIK MBH - Wikki**(911750434) - BENEFICIARY**
- GICON-GROSSMANN INGENIEUR CONSULT GMBH - GICON-GROSSMANN INGENIEUR CONSULT GMBH**(936701065) - BENEFICIARY**
- INSTYTUT BUDOWNICTWA WODNEGO POLSKIEJ AKADEMII NAUK - IBWPAN**(994505887) - BENEFICIARY**
- BM SUMER MUHENDISLIK DANISMANLIK EGITIM ARASTIRMA GELISTIRME SANAYI VETICARET LIMITED SIRKETI - **(912373562) - BENEFICIARY**
- NIRAS AS - NIRAS AS**(998006229) - BENEFICIARY**
- AQUATERA ATLANTICO SL - **(890903000) - BENEFICIARY**
- MONDRAGON GOI ESKOLA POLITEKNIKOA JOSE MARIA ARIZMENDIARRIETA S COOP - MGEP**(999855146) - BENEFICIARY**
- POLITECNICO DI TORINO - POLITO**(999977754) - BENEFICIARY**
- UNIVERSITEIT GENT - UGent**(999986096) - BENEFICIARY**
- SINTEF OCEAN AS - SO**(997806603) - BENEFICIARY**
- DANMARKS TEKNISKE UNIVERSITET - TECHNICAL UNIVERSITY OF DENMARK DTU**(999990655) - BENEFICIARY**

HORIZON-CL5-2023-D3-02-14
Digital twin for forecasting of power production to wind energy demand

TYPE OF ACTION

- **RIA –** Research and Innovation Action
- **Lump Sum** grant
- Expected **TRL 5** by the end of the project

EU CONTRIBUTION

- Per project: **6 M€**
- Total: **12 M€**

TIMING

- Call opening: **4 May 2023**
- Call closing: **5 September 2023**

HORIZON-CL5-2023-D3-02-14
Digital twin for forecasting of power production to wind energy demand

EXPECTED OUTCOME

- **Accurate** and **precise energy yield prediction** to ease investment decisions based on accurate simulations that take into account simultaneously predictions on Renewable Energy Production, Energy Consumption and Price Predictions.
- Enhanced **digital transformation of wind energy sector** by delivering the **next generation of digital twins**.

HORIZON-CL5-2023-D3-02-14
Digital twin for forecasting of power production to wind energy demand

SCOPE

The expected growth of both on-and offshore wind energy is enormous and many new wind parks are planned for the coming years. Experience from the existing wind farms shows the importance of a proper micrositing of the wind turbines as well their efficient interconnection within the farm. In addition, bringing wind farms together into clusters toward a wind power plant concept might induce long distance negative interaction between the farms, reducing their expected efficiency. This might happen both on- and offshore. The high amount of connected wind power and the expected increase during the coming years, requires that this technology has to be prepared to take a more important role as of its contribution to the reliability and security of the electricity system.

The objective of this topic is to develop **new digital twins** to optimise the exploitation of individual wind farms (**onshore**, **bottom-fixed offshore** and **floating offshore**) as well as wind farm clusters, in view of transforming them into virtual power plants delivering a **more reliable** and **secure electricity system**.

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Such a digital twin is expected to integrate [**at least three of the following bullet points**]:

- **Wind and weather forecast models** relevant for the full wind power production system (turbines, grid, transmission) (including the effects of external physical conditions such as temperatures, rain, turbulences, waves, and currents).
- **Spatial modelling**: medium (within wind farms) to long distance (between/along wind farm clusters) wake effects.
- **Interconnection optimisation** via simulations to satisfy grid connection requirements and agility in grid reconfiguration and provide ancillary services.
- Include **predictive maintenance**, **structural health** and **conditional monitoring**, and
- **End user** location and needs.

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The digital twin will **improve accurate energy yield prediction** and will **balance supply and demand side needs** and will help to **ease investment decisions** based on accurate simulations.

The models should incorporate other relevant parameters influencing the siting of wind farms, such as **ground conditions**, **noise impacts** and **environmental impacts** as well as representing the complex system in a map view format while considering time series data of each and every asset.

Infrastructure modelling of each and every asset should be executed via independent profiling based on past performance data and contextual data in view to deliver prediction at the level of each and every asset with as much accuracy as possible.

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The project should **focus on offshore or on onshore** wind power systems and make optimal use of **previously developed models**.

Validation should be carried out with **data of existing wind farms**. Cooperation with wind energy suppliers, OEM's, developers and O&M services can make the available data more accurate, resulting in better, more sustainable and eventually circular products and sector.

The project should also sufficiently invest in delivering a **cyber-secure system**. The projects is expected to build also on the digital twins developed under **Destination Earth**, which envisage to develop a high precision digital model of the Earth to model, monitor and simulate natural phenomena and related human activities.

For the **offshore** digital twin projects the **impact of other blue economy sectors**, islands, different land-sea interactions for near shore wind farms should be considered.

For **onshore** digital twin projects, the **build environment and different landscapes** should be considered, and cooperation is envisaged with the selected projects under topic HORIZON-CL5-2021-D3-03-05 Wind energy in the natural and social environment.

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It is expected that **one project on offshore** digital twin will be funded and **one on onshore** digital twin.

To support rapid market uptake, widespread application and further innovation based on the developed solutions, projects are invited to use **Open-Source solutions** when appropriate and clarify in case they choose not to use Open Source, so that they can support the planning of future large scale offshore wind installations. Free licensing is also a possibility to consider to support rapid market uptake.

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Selected projects will be **required to share knowledge**. Projects will acquire performance-related data in a **standard format** to support advancement and validation of R&I for the benefit of all projects through Artificial Intelligence methods.

This data and relevant meta-data may be shared with other projects (not supported through Horizon Europe, including relevant projects supported through the Innovation Fund) on reciprocal terms, preferably leveraging on the tools and services provided by the European Open Science Cloud (EOSC) and exploring workflows that can provide "FAIR-by-design" data, i.e., data that is FAIR from its generation, and with EU-based researchers having a legitimate interest.

GRAZIE PER L'ATTENZIONE!

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